APPENDIX C

AVES STUDY

DEVELOPMENT AND DEMONSTRATION OF ZERO- AND LOW-VOC RESIN TECHNOLOGY FOR ADVANCED CONTROL MEASURE DEVELOPMENT

FINAL REPORT

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March 29, 2001

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EXECUTIVE SUMMARY

The AQMD awarded a contract to AVES, an affiliate of ATC Associates Inc., to develop architectural coatings with a zero- or near-zero content of volatile organic compounds (VOCs). The coatings developed under this contract include exterior opaque stains, exterior and interior semitransparent stains, waterproofing sealers (clear), clear wood finishes, (lacquers), varnishes and sanding sealers. Along with the development of the coatings, the contract also required comparative side-by-side testing for performance and repairability of the new coatings, and coatings currently in commercial use by the industry and a field demonstration. Additionally, cost-effectiveness and environmental impacts of new coatings were also evaluated and compared with commercial coatings used today.

Architectural and Industrial Maintenance (AIM) coatings are one of the largest non-mobile sources of VOC emissions in the South Coast Basin. Their emissions exceed those of petroleum refining, degreasing and dry cleaning combined, and the combined VOC emissions from the 950 largest VOC-emitting facilities. It has been estimated that 25 percent of all hydrocarbons used as solvent are used in paints and coatings. Stains, waterproofing sealers and clear wood finishes used as architectural coatings contribute over 5 tons of VOC emissions per day into the South Coast Basin. These VOC emissions contribute to the formation of smog in the atmosphere. VOCs react photochemically with oxides of nitrogen to form ozone. Ozone causes shortness of breath, kills lung cells and is suspected of causing premature aging of the lungs. Ozone also damages plant life and certain materials. The VOCs also contribute to the formation of PM_{10} (particulate matter less than 10 microns in size). PM_{10} is another pollutant that adversely affects human health and limits visibility. Because these small particulate matters penetrate into the deepest regions of the lung, they affect pulmonary function and have been linked to increased deaths.

The AQMD issued a Request for Proposal (RFP) for the development and demonstration of zero- or low VOC architectural coatings cited above. The RFP required co-funding, and specified the completion of three tasks: 1. Identify and develop promising resin technologies that can be used in a zero- or low-VOC coating system; 2. Test the coating on a variety of substrates using industry standard test methods, and; 3. The preparation of a final report detailing all aspects of the project.

AVES and Adhesive Coatings Company (ADCO) formed a team to pursue the RFP, using ADCO's developed and patented zero-VOC, water-based resin technology called RESLIX® that was used to develop and demonstrate a zero-VOC metal coating system through the Innovative Clean Air Technology (ICAT) program of the California Air Resources Board (ARB). Based on the results of the competitive solicitation, AVES and ADCO were selected to develop and demonstrate zero, or low-VOC stains, waterproofing sealers, and clear wood finishes.

This Executive Summary includes some generalized conclusions from side-by-side comparison testing and field demonstration. They are:

1. Most performance characteristics of this new no-VOC wood coating system (including adhesion, beading, chemical resistance, coating penetration, dirt pick-up, dry time, mar resistance, moisture vapor transmission, stain blocking, print resistance, swelling, water uptake, and overall appearance) are equivalent to those of commercial coatings based on the side-by-side comparative testing results. Advantages of these no-VOC coatings include better grain raising for varnish, less color change (for lacquer, varnish, and sanding sealer), better moisture/UV resistance for exterior semitransparent stain, and better water repellent efficiency for waterproofing sealer. However, the dry time, freeze/thaw properties, pot life, mildew/fungus resistance, printing resistance, and stain blocking properties of these no-VOC waterborne coatings are not as good as those of solvent-based coatings.

2. Three popular commercially available water borne and solvent-based coating systems (both lacquer and varnish) were tested side-by-side with no-VOC lacquer and varnish topcoat systems for repair and refinishing. This new no-VOC varnish system showed the best overall appearance after repair, but had the highest coating usage because the two-component coating resulted in a limited pot life. The new no-VOC Lacquer system was the easiest to repair and showed the best gloss difference after repair.

3. In order to obtain the impartial opinion of experienced painters on the performance of the new coatings, the painters of Commercial Casework, Inc. in Fremont, California conducted a field demonstration of the new coating system as part of this study. The personnel from Commercial Casework were impressed with the new wood coatings due to faster dry times, ease of use, good appearance qualities, and the safer working environment resulting from the absence of solvents.

4. This new coating system unit price (cost per gallon) is lower than the unit price of the hybrid system, but higher than those of the solvent-based coating systems on the market. However, once all other long-term cost savings are factored in (no emission fees, water clean-up, and no disposal fees), this new coating system price is more attractive. In addition, use in stationary sources can eliminate the VOC emissions ceiling, allowing the increase of productivity due to unlimited no-VOC coating usage. Cumulative environmental impacts on this no-VOC coating system are insignificant, and no significant project-specific cost impacts are anticipated.

5. By using this new no-VOC water-based coating technology, the anticipated air emissions reduction and health risk reduction could be achieved. Therefore, commercialization of the proposed technology will provide an alternative for compliance with current and future emission standards for coating operations imposed by federal, state, and local government agencies.

SECTION 1.0 - INTRODUCTION

1.1 Scope

The scope of this project was to develop several architectural coatings that are commercially used in relatively large volumes, with zero, or low VOC content and demonstrate their technical, environmental and economic feasibility to further reduce VOC emissions in the basin. The coatings developed under this project are: opaque stains, exterior and interior semi-transparent stains, waterproofing sealers (clear), clear wood finishes (lacquers), varnishes, and sanding sealers.

1.2 Background

The 1999 Air Quality Management Plan (AQMP) addresses emission reductions from architectural coatings in a control measure entitled "Further Emission Reductions from Architectural Coatings and clean-up solvents (Rule 1113)" CM#99CTS-07 (P3). CM#99CTS-07 (P3) requires additional reduction in VOC emissions. Over the past four years, Rule 1113 was amended twice to achieve a 55% emission reduction in two phases. In phase I, Rule 1113 was amended on November 2, 1996 to achieve approximately 17.5% (10.3 tons/day (t/d)) emission reductions. In phase II, an additional 38% (21.8 t/d) emission reduction was achieved with the amendment of May 14, 1999.

The final 20% (10 t/d) emission reduction, as required by CM#99CTS-07 (P3), necessitates the development and commercialization of zero– and low-VOC architectural coatings in certain large-volume categories. The AQMD Staff identified stains, waterproofing sealers, and clear wood finishes as large-volume coatings that contribute over 5 t/d of VOC emissions to the atmosphere. This project is designed to develop and demonstrate zero– and low–VOC technology that can be utilized by AQMD staff in their technology assessment for further rulemaking in these categories.

AVES has teamed with ADCO, a firm specializing in the development of zero–VOC water–based coatings. ADCO developed and patented a zero–VOC, water–based resin technology called RESILEX®, which was used to develop and demonstrate a zero-VOC metal coating system through the Innovative Clean Air Technology (ICAT) program of the California Air Resources Board (ARB).

1.3 Potential Air Quality Benefits

The modified RESILEX® resin was the backbone resin used in the development of several coatings under this project.

Most of the emission reduction was from a requirement that flat house paints contain 60% fewer VOCs by July 2001, and no more than 50 grams per liter of VOCs by July 2008. The latter will effectively require that flat paints be nearly solvent free by 2008. The rule also required reductions in the VOC content of lacquers (which was also a part of this study), traffic paints, and specialty multi-color coatings.

The commercial use of zero-VOC coatings developed under this project will result in further VOC emission reductions in the Basin. According to the 1999 ARB survey of 1996 coatings, the VOC emissions from these coatings are over 5 tons per day in the South Coast Basin (see Table 1-1). If new coating systems (less than 50 g/l) are successfully implemented, over 2.56 tons per day of further VOC emissions reduction from these new coating categories beyond potential reduction with future rule limit would be achieved.

Table 1-1 ARB Coating Survey

Coating Category	VOC Emissions (tons/day)	Potential Reduction with Future Limit (tons/day)	Further Reduction with No-VOC Coatings (tons/day)
Clear Wood Finishes – Lacquers	1.53	1.11	0.37
Semitransparent Stains	1.17	0.38	0.67
Clear Wood Finishes – Varnishes	1.11		1.03
Waterproofing Sealers	0.76	0.52	0.21
Clear Wood Finishes - Sanding	0.21	0.01	0.19
Opaque Stains	0.23	0.12	0.09
Total	**5.01**	**2.14**	**2.56**

VOC emissions reduction calculation details are attached in Appendix F.

SECTION 2.0 - TECHNOLOGY DEVELOPMENT

2.1 Identification and Development of Promising Resin Technologies for Low- or Zero-VOC Coating Systems

2.1.1 Desired Resin Characteristics

During the 1990s, numerous manufacturers have developed and marketed acrylic-based, waterborne coatings that exhibit performance characteristics equivalent to or superior to the traditional solvent-based coatings. The first generation of waterborne coatings had stability, rheology, water-immersion, loss of gloss, lack of corrosion resistance, loss of drying capacity, and bacterial degradation problems. However, subsequent formulations, using a new generation of performance enhancing additives, as well as innovative resin technologies, have minimized the problems to a practical level, or completely eliminated them. Technology breakthroughs include the following:

- Flow and leveling agents that mitigate the flow problems, even on substrates like plastic, glass, concrete, and resinous wood. These additives even assist in overcoming flow and leveling problems when coating oily or contaminated substrates.

- Pigment-wetting agents have assisted in better dispersion of organic pigments in an aqueous media by altering their hydrophobic nature. This results in better rheology characteristics.

- Defoamers and microfoam agents have mitigated the bubble retention problems, thereby eliminating the loss of drying capacity, and thus improving the film.

- Biocides that are not susceptible to degradation by hydrolysis have provided good stability and eliminated the settling problems.

With the development of these additives, some waterborne coatings now perform better than solvent-based coatings. The biggest problem with waterborne coatings is the dry time. Water, with its slow evaporation rate and high latent heat of evaporation, does not have the latitude that solvents do with their wide range of evaporation rates and boiling points. On a warm, dry day, waterborne coatings dry faster than the high-solids, solvent-based coatings, but the dry times can be significantly extended on cold, humid days, which causes problems in some areas. However, with the development of non-volatile, reactive diluents combined with hypersurfactants, performance of these nearly zero-VOC coatings has equaled, and in some characteristics, outperformed traditional, solvent containing coatings.

The durability of a coating is governed by the nature of the binder (also known as film formers or resins) used in its formulation. Typical coated substrates are exposed to a

variety of influences of daily life, including mechanical stresses, chemicals and weathering, against which they serve to protect the substrate. The major impact on the exterior coating film is oxidation by exposure to light, causing the film to first lose color and gloss, and gradually become brittle and incoherent. This is mainly caused by a process known as photochemical degradation. This is especially the case for coatings used for exterior painting.

The coatings industry has developed a variety of additives that act as ultraviolet light (UV) absorbers or free-radical scavengers that ultimately slow down the photo-oxidative process, thereby increasing the coating life. Antioxidants and sterically hindered amines are two classes of free-radical scavengers, also known as hindered amine light stabilizers (HALS). These can be used with solvent-free or waterborne coatings. Other additives that have positive effect on durability of coatings include adhesion promoters. corrosion inhibitors, curing agents, reactive diluents, optical brightners, and algaecides/mildewcides.

At the start of this project, AVES, ADCO and AQMD staff listed the desired following performance properties of this resin technology to formulate coatings:

1. No VOCs/no Hazardous Air Pollutants (HAPs)
2. Rapid dry (initial) characteristics upon application
3. Hardness
4. Flexibility
5. Chemical resistance
6. Durability
7. Minimized deterioration
8. Coverage

2.1.2 Identification of New Zero-VOC Resin Technology

In the past, products have typically been developed and marketed that attempt to increase emulsion molecular weight in order to enhance film properties but also required solvents to help the polymer to coalesce. The addition of solvents results in coatings that are odoriferous and potentially hazardous. ADCO's patented innovation-RESILEX®, a resin emulsion in water alters the distribution of the molecular weights of a resin and results in an innovative technology and product which has four unique properties: (1) a unique distribution of molecular weights; (2) the presence of a unique high molecular weight polymer which is insoluble in many strong organic solvents yet is soluble in this resin emulsion; (3) the ability to coalesce at temperatures below their normal glass transition temperature when added to other waterborne polymers; and (4) a superior binder system for the formation of a high performance coating.

RESILEX® was engineered as the next step beyond conventional water-based emulsion systems. Based on earlier test results of this resin system, ADCO's technology

provides a solvent-free, water-borne polymer that exhibits, in a final paint film, better film properties (hardness, flexibility, chemical resistance, and overall durability) than even some of the newest emulsions on the market. Unlike most zero-VOC coatings, ADCO's polymer had better ultraviolet radiation resistance and flexibility while maintaining superior hardness. RESILEX® is colorless, odorless, and VOC- and hazardous air pollutant (HAP)-free. RESILEX® can be used (1) as a resin system alone, (2) in combination with other water-based resin systems, or (3) as an enhancement in latex paint formulations to provide greater durability.

In addition, the Team used a non-yellowing urethane acrylic resin that provides excellent falling sand and high impact resistance to coating and adhesive formulations. The resin was used as a base resin or combined with various monomers. This resin system offers exceptional flexibility, clarity, and excellent heat and light stability to UV/EB cured products.

2.1.3 Formulating Candidate Coatings

The goal of the project was to develop and demonstrate zero-VOC or low-VOC coatings (varnish, lacquer, interior and exterior stains, waterproofing sealers and sanding sealers) to further reduce VOC emissions in the Basin.

The task to develop these coatings was focused on making the necessary formulation adjustments to ADCO's patented polymer emulsion. This emulsion was used as the basis for formulating the required stains, sealers, and clear wood finishes while producing products with VOCs less than 10 g/l (calculated from GC/MS analysis results).

The target in developing the coatings was to achieve a performance level equal to, or better than that of similar coatings widely used by the industry. The performance characteristics in the new coatings were focused on the following areas: hardness, hot/cold check, adhesion, printing/blocking, household chemical resistance, drying time, moisture resistance, UV resistance, freeze/thaw, orange peel, leveling, sagging, film thickness, mildew/fungus resistance, dirt pick-up, substrate penetration, stain blocking, water repellant efficiency, beading, swelling, moisture vapor transmission, scrape/mar resistance, color change, sprayability, clarity, depth, gloss, graininess, etc.

The characteristics of the raw materials are of great importance to the creation of a water borne resin system that dries quickly and exhibits good initial film properties without coalescing solvents. Particle size, minimum film forming temperature, glass transition temperature, resin polarity, and dynamic surface tension are among the most important factors to consider in the formulation.

2.1.3.1 Lacquers

Lacquers are clear wood finishes (including lacquer sanding sealers) formulated with nitrocellulose or synthetic resins that dry by evaporation with no chemical reaction characteristics.

The new zero-VOC lacquer is a water reducible, air-dry polyurethane and acrylic copolymer. This approach includes blending of pre-existing commercial and proprietary polymers and creating hybrid polymers (graft) prior to dispersion in water.

2.1.3.2 Varnishes

Varnishes are clear, wood finishes formulated with various resins to dry by chemical reaction upon exposure to air.

The new zero-VOC clear wood topcoat is a two-part, chemically cured, water reducible, air-dry epoxy coating. It can be used as a sealant and as a high gloss, durable topcoat giving a clear finish. The absence of organic solvents in the formulation or their formation during curing results in zero emission of VOCs and HAPs.

The two part varnish consists of RESILEX® (Part A), and curing agents (Part B). Tests of polymer variations of RESILEX® (Part A), in combination with each of several proprietary curing agents (Part B) were conducted. Various mixing ratios were evaluated for each Part A/Part B combination, and the best ratio was selected for further evaluation. This evaluation consisted of applying these coatings onto panels, and testing for dry time, adhesion, appearance, and chemical resistance.

2.1.3.3 Waterproofing Sealers

Waterproofing sealers are colorless coatings that are formulated specifically for (1) prevention of water penetration of porous substrates, and (2) preservation of surface appearance or texture.

The new no-VOC waterproofing sealer is a water reducible, air-dry special hydrophobic acrylic copolymer. The new waterproofing sealer is a clear, water borne protective coating for use on many types of surfaces, including wood and concrete. It seals, water proofs, and dust proofs the surface. Waterproofing sealers help prevent water damage by reducing water absorption in various porous materials.

2.1.3.4 Sanding Sealers

Sanding sealers are clear wood coatings formulated for and applied to bare wood in preparation for sanding and to seal the wood for subsequent application of coatings.

The no-VOC sanding sealer is a water reducible, air-dry acrylic copolymer. The polymer has a unique mix of molecules with different molecular weights. Because of its

unique structure, it allowed the replacement of all of the coalescent in the sanding-sealer with no-VOC resin solids. The sanding sealer is compatible with the no-VOC topcoat and stains. This formulation has good sandability, minimum wood yellowing, and good intercoat adhesion.

2.1.3.5 Stains

Stains are opaque or semi-transparent coatings that are formulated to change the color but not conceal the grain pattern or texture of wood or other porous materials.

The zero-VOC stains are ultra-fine acrylic resin dispersions with surfactants, fungicides (exterior stain only), U. V. absorbers (exterior stain only), and zero-VOC pigment dispersions. The resin provides a solution-like appearance and penetration properties along with reduced grain rising. The new zero-VOC stains have the following features:

- Small Particle Size Emulsion - The ultra fine particle size allows for deep penetration into wood substrates with minimum grain raising.
- Excellent Film Formation Characteristics - Require no coalescing solvent.
- Good Color Development and Clarity - Stains show good color strength due to the inherent clarity of the polymer used.
- Easy to apply with good workability.
- Low odor.

The stains combine the best features of linseed oil and acrylic latex for superior color retention, adhesion, penetration and durability. The no-VOC resin system used in stain does not form a traditional type of film, but instead permits the wood to breathe and release moisture which eliminates cracking, peeling and blistering, while providing resistance to weathering, chalking, and erosion.

SECTION 3.0 - TESTS AND RESULTS

The newly developed coatings were tested for their performance and VOC content. The tests are divided in the following categories:

- VOC Determination
- Comparative Performance Properties
- Comparative Repair/Refinishing
- Field Demonstration

3.1 VOC Determination

This task was focused on confirming VOC contents of new coatings formulated for this project. The following new no-VOC coatings were tested:

1. Wood Lacquer
2. Wood varnish (Part A and Part B)
3. Wood sanding sealer
4. Exterior opaque stains
5. Exterior semi-transparent stains
6. Interior semi-transparent stains
7. Waterproofing sealer

All coatings were prepared in ADCO's laboratory and analyzed in an independent testing laboratory (APC Laboratory, Chino, California). The ASTM methods that were followed to verify VOC/HAP content are summarized in Table 3-1.

Table 3-1 Methods Used for VOC and HAP Air Emission Testing

Measurement	Method
VOC	AQMD Method 304
Volatile content	ASTM-D-2369
Density	ASTM-D-1475
Water content	ASTM-D-3792 (GC)
HAP	EPA Method 8240 (GC/MS)

Table 3-2 VOC Measurements for New Coatings by GC/MS

Coating Category	VOC Content (g/l)
Clear Wood Finishes – Lacquers	<10
Clear Wood Finishes – Varnishes	<10
Sanding Sealers	<10
Waterproofing Sealers	<10
Exterior Semitransparent Stains	<10
Interior Semitransparent Stains	<10
Opaque Stains	<10

Analysis by GC/MS confirmed that VOC contents were less than 10 g/l (VOC contents less than 50 g/l cannot be calculated accurately by the EPA Method 24 or AQMD Method 304).

3.2 Comparative Performance Properties

Extensive testing was performed to compare a wide range of performance properties of each of the newly developed coatings with the performance properties of the last three functionally similar coatings commercially used by the industry. The purpose of these tests was to determine how well each of the new coatings performs compared to similar coatings that are widely accepted and used by the industry. In addition to comparing the individual coatings, the performance properties of the new and currently used coating systems, comprising of semi-transparent stains, sanding sealers and topcoats (lacquers and varnish), were also compared.

All comparative testing, except five specialized tests, were conducted at the warehouse of ADCO's laboratory. The laboratory is located within the warehouse, which is greatly impacted by external temperatures and humidity conditions, as well as soil dust from operations directly across the street. The environmental conditions are estimated as follows:

Conditions:	Temperature:	45°-75°F
	Relative Humidity:	40%-65%

Five specialized tests, which included mildew/fungus resistance, dirt pick-up, stain blocking, water repellence, and moisture vapor transmission were subcontracted to Calcoast Laboratory located in Emeryville, California. Calcoast laboratory specializes in conducting a variety of tests on coatings and is equipped to run ASTM, FM and other specialized tests (see attached brochure in Appendix G).

The following individual coatings were selected for comparative testing:

1. New wood Lacquer and 3 commercial clear wood coatings including a nitrocellulose lacquer
2. New wood varnish and 3 commercial varnishes
3. New wood sanding sealer and 3 commercial sanding sealers
4. New exterior opaque stains and 3 commercial opaque stains
5. New exterior semi-transparent stains and 3 commercial semi-transparent stains
6. New interior semi-transparent stains and 3 commercial semi-transparent stains
7. New waterproofing sealer and 3 commercial waterproofing sealers for concrete and wood

Three coating systems were used in this testing are as follows:

1. System 1: Semi-transparent stain/sanding sealer/varnish
2. System 2: Semi-transparent stain/sanding sealer/lacquer (two coats)
3. System 3: Semi-transparent stain/sanding sealer/lacquer (three coats)

The comparative performance tests conducted on each coating and coating system are listed below. The test method used for comparative performance tests are included in Appendix A (Test Protocol for Comparative Performance Tests). The results of the comparative tests are included in Appendix B (Results of Comparative Performance Tests).

3.2.1 Lacquer

Application Method

Surface Preparation: Bare wood surfaces were sanded to a smooth uniform surface with 120-grit sandpaper. All dust was removed. For stained surfaces, the stain was allowed to dry overnight. The sanding sealers were then applied, sanded lightly with 220-grit sandpaper and the dust was removed.

Application: The lacquer was stirred thoroughly, and not shaken. Lacquer was applied by conventional air gun (number 66 tip). The lacquer was applied approximately three mils thick per wet coat. Three coats were applied over bare wood. For system application, two coats over a sealer and a stain were applied for appearance and durability.

Test Results

Comparative Tests Performed	New Coating Performance
Wet Film Thickness:	Equivalent
Freeze/Thaw:	Inferior
Dry Time:	
Set to touch	Equivalent to waterborne, slower than nitrocellulose

Tack free	Equivalent to waterborne, slower than nitrocellulose
Dry through	Equivalent to waterborne, slower than nitrocellulose
Dry hard	Equivalent to waterborne, slower than nitrocellulose
Gloss:	Equivalent
Grain Raising:	Equivalent
Orange Peel:	Equivalent
Printing Resistance:	Equivalent to waterborne, worse than nitrocellulose
Adhesion:	Equivalent
Appearance:	
Flow	Equivalent to waterborne, better than nitrocellulose
Color	Equivalent
Depth	Equivalent or Better
Color change	Superior
Hot/Cold check	Equivalent or Better
Sprayability	Equivalent
Sag	Equivalent to waterborne, worse than nitrocellulose

3.2.2 Varnish

Application Method

Surface Preparation: Bare wood surfaces were sanded to a smooth uniform surface with 120-grit sandpaper. All dust was removed. For stained surfaces, the stain was allowed to dry overnight. The sanding sealers were then applied, and sanded lightly with 220-grit sandpaper, and the dust was removed.

Application: The varnish was a two-component epoxy coating (Part A and Part B). The mix ratio was 2 parts of B to one part of A. While stirring Part A, Part B was slowly added, and mixed for 3-4 minutes. The varnish was used within 4 hours from the time of mixing and any catalyzed varnish was discarded. The varnish was applied by conventional air gun (number 66 tip). The varnish was applied approximately three mils thick per wet coat. Two coats were applied over bare wood. For system application, two coats over a sealer and a stain were applied for appearance and durability.

Test Results

Comparative Tests Performed	New Coating Performance
Wet Film Thickness:	Equivalent
Freeze/Thaw:	Inferior
Dry Time:	
Set to touch	Equivalent to waterborne, longer than solvent based
Tack free	Equivalent to waterborne, longer than solvent based
Dry through	Equivalent to waterborne, longer than solvent based
Dry hard	Equivalent to waterborne, longer than solvent based
Gloss:	Equivalent to waterborne, lower than solvent based
Grain Raising:	Superior
Orange Peel:	Equivalent
Printing Resistance:	Equivalent
Adhesion:	Equivalent or better

Appearance:	
Flow	Inferior
Color	Equivalent
Depth	Equivalent to waterborne, worse than solvent based
Color change	Superior
Hold/check	Equivalent
Sprayability	Equivalent
Sag	Superior
Pot life	Inferior due to two-component system

3.2.3 Exterior Opaque Stain

Application Method

Surface Preparation: New wood surfaces were prepared by removing all loose wood fibers with a stiff bristle brush. All surfaces were clean and free of all dust, mildew, oil, soot, and other contaminants. Smooth wood and mill glazed wood was sanded.

Application: The stain was stirred thoroughly, and applied using a synthetic bristle brush. On rough woods, the stain was back brushed while wet to force the stain into all the texture of the wood. Two coats were applied to new rough sawn woods.

Test Results

Comparative Tests Performed	New Coating Performance
Dry Time:	
Set to touch	Inferior
Tack free	Quicker than some but not as quick as others
Dry through	Quicker than some but not as quick as others
Dry hard	Quicker than some but not as quick as others
Grain Raising:	Equivalent
Freeze/Thaw:	Inferior
Coating Penetration:	Equivalent or Better
Stain Blocking:	
Extent	Equivalent
Severity	Equivalent
Mildew/Fungus Resistance:	Equivalent to waterborne, worse than solvent based
Dirt Pick-up:	Equivalent or worse
Color change:	Superior
Moisture Resistance:	Equivalent
UV Resistance:	Equivalent or better

3.2.4 Exterior Semitransparent Stain

Application Method

Surface Preparation: New wood surfaces were prepared by removing all loose wood fibers with a stiff bristle brush. All surfaces were clean and free of all dust, mildew, oil, soot, and other contaminants. Smooth wood and mill glazed wood was sanded.

Application: The stain was stirred thoroughly, and applied using a synthetic bristle brush. On rough woods, the stain was back brushed while wet to force the stain into all the texture of the wood. Two coats were applied to new rough sawn woods.

Test Results

Comparative Tests Performed	New Coating Performance
Dry Time:	
Set to touch	Better
Tack free	Better
Dry through	Equivalent or Better
Dry hard	Equivalent or Better
Grain Raising:	Equivalent
Freeze/Thaw:	Inferior
Coating Penetration:	Equivalent or Better
Stain Blocking:	
Extent	Equivalent or worse
Severity	Equivalent or worse
Mildew/Fungus Resistance:	Inferior
Dirt Pick-up:	Equivalent or worse
Color change:	Best
Moisture Resistance (final appearance):	Better
UV Resistance (final appearance):	Better

3.2.5 Interior Semitransparent Stain

Application Method

Surface Preparation: New wood surfaces were prepared by removing all loose wood fibers with a stiff bristle brush. All surfaces were cleaned and free of all dust, mildew, oil, soot, and other contaminants.

Application: The stain was stirred thoroughly, and applied using a nylon polyester brush. The stain was allowed to penetrate until the desired color was achieved but was not allowed to dry out. While the stain was still wet, excess stain was removed using a clean cloth. During the removal of excess stain, the wood was wiped in the direction of the wood grain. A second application of the stain was then applied to intensify the color

by letting the first coat dry for 1 hour. The stain was allowed to dry at least 3 hours before it was topcoated.

Test Results

Comparative Tests Performed	New Coating Performance
Dry Time:	
Set to touch	Best
Tack free	Best
Dry through	Better
Dry hard	Better
Grain Raising:	Equivalent or worse
Freeze/Thaw:	Equivalent
Finish:	Equivalent
Grain Definition:	Equivalent or worse

3.2.6 Sanding Sealer

Application Method

Surface Preparation: The wood surfaces were clean and dry. For new wood, the surface was sanded lightly with 120-grit sandpaper with the direction of the grain. All surfaces were cleaned and free of all dust, mildew, oil, soot, and other contaminants. For stained surfaces, the stain was allowed to dry overnight before the sealer was applied.

Application: The sanding sealer was stirred thoroughly and applied using a conventional air gun (number 66 tip). Approximately 3-4 mils of wet spray coat was applied. The sealer was sanded after being allowed to dry for 3 hours. A minimum amount of grain rise occurred. The sealer was sanded with 220 grit sandpaper before the topcoat was applied.

Test Results

Comparative Tests Performed	New Coating Performance
Freeze/Thaw:	Equivalent
Dry Time:	
Set to touch	Equivalent or worse
Tack free	Equivalent or worse
Dry through	Equivalent or worse
Dry hard	Equivalent or worse
Grain Raising:	Equivalent or worse
Appearance:	Equivalent
Flow	Equivalent
Color change	Better
Sprayability	Equivalent

Sag	Equivalent or worse

3.2.7 Waterproofing Sealer

Application Method

Surface Preparation: New wood surfaces were prepared by removing all loose wood fibers with a stiff bristle brush. All surfaces (wood and concrete) were clean and free of all dust, mildew, oil, soot, and other contaminants.

Application: The stain was stirred thoroughly and applied using a brush. The sealer was applied until a puddle remained on the surface for 2 minutes. Any residual sealer was then redistributed and the excess was removed.

Test Results for Wood Substrate

Comparative Tests Performed	New Coating Performance
Freeze/Thaw:	Worse
Moisture Vapor Transmission:	Equivalent or Better
Water Repellent Efficiency:	Better
Swell:	Equivalent
Water Uptake:	Equivalent

Test Results for Concrete

Comparative Tests Performed	New Coating Performance
Freeze/Thaw:	Worse
Moisture Vapor Transmission:	Equivalent or Better
Beading:	Equivalent or Better
Coating Penetration:	Better

3.2.8 System 1 Test Results

System 1 is comprised of stain, sanding sealer, and two coats of varnish.

Comparative Tests Performed	New Coating Performance
Mar Resistance:	Equivalent or Better
Wet Film Thickness:	Equivalent
Color change	Equivalent
Household Chemical Resistance:	
Water	Equivalent or Better
Windex	Equivalent or Better
Espresso	Equivalent or Better
Mustard	Better
Vodka	Equivalent
Grease	Equivalent
Motor Oil	Equivalent
Pencil Hardness:	Equivalent or Better

Adhesion:	Equivalent or Better
Printing Resistance:	Equivalent
Appearance:	
Depth	Equivalent
Orange Peel	Equivalent
Gloss	Equivalent or worse

3.2.9 System 2 Test Results

System 2 is comprised of stain, sanding sealer, and two coats of lacquer.

Comparative Tests Performed	New Coating Performance
Mar Resistance:	Equivalent or Worse
Wet Film Thickness:	Equivalent
Color change	Equivalent
Household Chemical Resistance:	
Water	Equivalent or Worse
Windex	Equivalent or Worse
Espresso	Equivalent or Worse
Mustard	Equivalent
Vodka	Inferior
Grease	Equivalent
Motor Oil	Equivalent
Pencil Hardness:	Equivalent or Better
Adhesion:	Equivalent or Better
Printing Resistance:	Equivalent or Worse
Appearance:	
Depth	Equivalent or Better
Orange Peel	Equivalent or Better
Gloss	Equivalent or Worse

3.2.10 System 3 Test Results

System 3 is comprised of stain, sanding sealer, and three coats of lacquer.

Comparative Tests Performed	New Coating Performance
Mar Resistance:	Equivalent or Worse
Wet Film Thickness:	Equivalent
Color change	Equivalent
Household Chemical Resistance:	
Water	Equivalent or Worse
Windex	Equivalent or Worse
Espresso	Equivalent
Mustard	Equivalent or Worse
Vodka	Equivalent or Worse
Grease	Equivalent or Better
Motor Oil	Equivalent
Pencil Hardness:	Equivalent or Better
Adhesion:	Equivalent or Better
Printing Resistance:	Equivalent or Better

Appearance:

Depth	Equivalent or Better
Orange Peel	Equivalent or Better
Gloss	Equivalent or Worse

3.3 Comparative Repair/Refinishing

There are many reasons for refinishing or repair. Typical reasons for refinishing include:

Damage caused in manufacturing (e.g., glue marks, putty marks, scratches, gouges, nail or screw holes, poor joints).

Flaws in the grains of the wood (e.g., sap wood, light vs. dark grain, splits or cracks). Some may just require shading in the finishing process.

Handling or stacking damage (e.g., printing/blocking, scuff marks, light scratches, deep scratches, gouges, chips, rub marks).

Flaws in the finish process (e.g., incomplete finishing, runs, sags, over spray).

Usually, the defects from items one and two above are found and repaired in the finish room. Some of the flaws described above are very easy to repair, while others require a great deal of skill. In general, solvent-based coatings are easier to repair since a new layer of coatings can merge with the existing layer (i.e. the existing layer opens up after solvent contact). Water-based coatings typically require sanding between new layer and existing layer.

Three popular commercially available coating systems (both lacquer and varnish) were tested side-by-side with no-VOC lacquer and varnish topcoat systems for repair and refinishing. The system panels used for repair testing were prepared for side-by-side laboratory comparison testing. All side-by-side repair tests were conducted in ADCO's laboratory (Oakland, CA), by ADCO staff. Using the panel made to check chemical resistance (Oak plywood panel coated with semi-transparent stain, sanding sealer and topcoat), a scratch was applied at least one inch long across the grain. A scratch was made perpendicular to the grain using the loaded beam apparatus mentioned in the mar resistance method. The beam was loaded with a 1000 grams weight and the marking tool was a steel #13 yarn needle at 45° to surface. Sand paper (#220 grit) was used to lightly sand the scratch area to improve the adhesion. After the panel was cleaned and dust was removed, a first topcoat was brushed on to fill the scratch. After the first coat dried, the second coat was then sprayed on. Three sets of pictures were taken for each panel (before the scratch, after the scratch, and after the repair). In a typical field application, only topcoat is used to repair a scratch. If there is a large area of damage, then stain, sanding sealer, and topcoat are used for the repair.

Repair procedures for finishes are very system dependent. If an applicator is more experienced with one type of finish, it will be easier for him to repair. However, the

learning process is necessary for a good repair. The repair test was homogenized to treat all finishes the same way. This may not be fair for all coatings (realizing that most coatings were developed for some specific practice or property). Each coating system was composed of interior semitransparent stain, sanding sealer, and topcoat. All coating systems tested for repair and refinishing were examined by visual analysis in terms of color difference on repair, gloss difference on repair, speed of repair, ease to repair, and overall appearance. The following tables summarized results of all coating systems tested for repair and refinishing.

Table 3-3 Varnish System Summary

Manufacturer	Stain / Sanding Sealer /Varnish - 2 coats	Repair and Refinishing (0-5, 5-best)				
		Ease of Repair	Speed of Repair	Gloss Difference of Repair	Color Difference of Repair	Overall Appearance
S1-A	WST-5 / WSS-9D / WTC-99	2	4	4	4	5
S1-B	Wood Finish# 224 / Classic FastDry Sanding Sealer / Fast Drying Polyurethane	4	2	4	4	3
S1-C	Stainseal II/ Pro Finisher sanding sealer # 13-7163 / Heirloom Varnish	4	1	3	2	2
S1-D	Diamond wood stain / Pro Finisher sanding sealer #13-7163 / Mega waterborne floor finish	5	4	4	4	4

S1-C varnish took the longest time to dry and left a noticeable patch (the picture did not show the patch, but the physical patch was darker in color with a bumpy surface which resulted in a gloss patch). S1-A varnish repaired well but had the highest use level because of the defined pot life (this is a two-component coating, unused coating was wasted after its pot life). S1-B polyurethane did well in the evenness of gloss but additional sanding was necessary to prevent an adhesion failure.

Table 3-4 Lacquer System Summary

Manufacturer	Stain / Sanding Sealer / Lacquer - 2 coats	Repair and Refinishing (0-5, 5-best)				
		Ease of Repair	Speed of Repair	Gloss Difference of Repair	Color Difference of Repair	Overall Appearance
S2-A	WST-5 / WSS-9D / WLQ-6C	5	4	5	4	3
S2-B	Wood Finish# 224 / Classic FastDry Sanding Sealer / Polycrylic Finish	5	4	4	4	3
S2-C	Decolac II lacquer stain #LQ122 / 550 Crystclear LQ 150-0 Sanding Sealer / 550 Crystaclear LQ 153-0	3	5	4	5	4
S2-D	Diamond wood stain / Pro Finisher S/S # 13-7163 / AQUAZAR waterborne urethane	5	4	4	4	5

S2-C lacquer had the highest use level because of its low solid content and the large area required for blending the topcoat. S2-D has the best overall appearance while S2-A has the best gloss difference after repair (see Appendix C for pictures taken before scratch, after scratch, and after repair).

3.4 Field Demonstration

The purpose of the demonstration was to obtain the impartial opinion of experienced painters on the performance of the new coatings in a real world (woodworking/painting facility) environment. The demonstration of the new coating system was conducted at Commercial Casework, Inc. in Fremont, California, on December 13, 2000. Commercial Casework manufactures high-end finished panels, desks, reception counters and other miscellaneous office furniture and architectural wood products. The painters of Commercial Casework, Inc conducted the field demonstration. The following summarizes the demonstration process.

Date: December 13, 2000

Place: Commercial Casework, Inc.
41780 Christy Street
Fremont, CA 94538

Present: Mr. Naveen Berry - SCAQMD
Mr. Rich Hosman - Commercial Casework, Inc.
Mr. Jeff Wong - Commercial Casework, Inc.
Mr. Guillermo Garcia - Commercial Casework, Inc.

Products used: New Lacquer (WLQ-6C)
New Varnish (WTC-99)
New Sanding Sealer (WSS-9D)
New Stain (WST-5)

		Interior	Exterior
Conditions:	Temperature:	72°F	50°F (estimated)
	Relative Humidity:	50%	90% (estimated)

This facility has an overhead heater at about 18 feet above the finished floor in the coating area. Two oak laminate panels were laid out on finishing racks. The panels were lightly sanded and dust was removed using pressurized air. The stains (WST-5) were applied to the wood products by rubbing with a rag until an even color was achieved. The stains were easy to work with, blended well, and gave a pleasing appearance.

Five minutes later, the sanding sealer (WSS-9D) was applied to all panels at package viscosity using a Binks 2000 cup gun (tip number 66). Sanding sealer dried in seven minutes. This was allowed to cure (about thirty minutes) before sanding. Using 280-grit sandpaper, the sanding sealer was easily sanded, resulting in a powder that was easily wiped off. No gumminess or sticky residue was noted.

After sanding and dusting, the new topcoats were applied using the same gun at package viscosity. One of the panels was coated with lacquer and the other with varnish. Results of the topcoat application are discussed below:

Lacquer System (WLQ-6C)

The first coat of lacquer was applied at 10:30 a.m. and dried at 10:42 a.m. There was some orange peel observed on the dried film (orange peel is an irregularity in the surface of a paint film resulting from the inability of the wet film to "level out" after being applied. Orange peel appears as a characteristically uneven or dimpled surface to the eye, but usually feels smooth to the touch.). The second coat was applied at 10:47 a.m. and dried at 11:00 a.m. The second coat exhibited some orange peel also. The third coat dried in approximately 12 minutes with improving flow and leveling. Depth also improved. The fourth coat dried in approximately 12 minutes with very good flow and depth. Gloss was about 85 on a 60 ° degree gloss meter. No orange peel was noted on the fourth coat.

Varnish System (WTC-99)

The first coat of the two-component varnish was applied at 10:34 a.m. and dried at 11:05 a.m. There was some initial milky appearance, which cleared upon curing. The second coat was applied at 11:06 a.m. and dried at 11:21 a.m. The second coat appeared milky but cleared upon curing. However, some yellowness was noted. Gloss was about 80 on a 60 º degree gloss meter.

The personnel from Commercial Casework were impressed with the new wood coatings for the following reasons:

1. Stains dried very fast.
2. Sanding sealer applied easily and powdered very well.
3. Lacquer dried fast and was not milky.
4. Although slightly milky, after completely dry, the varnish dried fast with good appearance.
5. The absence of solvents results in a safer working environment .

The complete field demonstration results are summarized in Appendix D.

SECTION 4.0 - COST AND ENVIRONMENTAL ANALYSIS

4.1 Cost Comparison of Zero-VOC and Conventional Coatings

The new no-VOC coatings and the conventional coating systems (nitrocellulose system, high solid system, and hybrid system) were sprayed on wood panels. Tables 4-1a and 4-1b, 4-1c and 4-1d list comparisons of VOC contents, solid contents, and cost per gallon between conventional coatings and no-VOC wood coatings.

Table 4-1a Coating Comparisons – Lacquer

	No-VOC Coating	Conventional Coating		
	CWF - A	CWF – B	CWF - C	CWF - D
Coating VOC Content *	0 g/l	350 g/l	548 g/l	328 g/l
Material VOC Content	0 g/l	120 g/l	223 g/l	149 g/l
Solid Content (by Volume)**	28%	27.5 %	13.5 %	28%
Cost ***	$32.99/gal	$29.97/gal	$22.55/gal	$29.97/gal

Table 4-1b Coating Comparisons – Varnish

	No-VOC Coating	Conventional Coating		
	V - A	V – B	V - C	V - D
Coating VOC Content *	0 g/l	450 g/l	350 g/l	250 g/l
Material VOC Content	0 g/l	350 g/l	328 g/l	100 g/l
Solid Content (by Volume) **	30%	58%	56 %	30 %
Cost***	$42.99/gal	$32.47/gal	$29.60/gal	$54.96/gal

TABLE 4-1c Coating Comparisons – Sanding Sealer

	No-VOC Coating	Conventional Coating		
	SS - A	SS - B	SS - C	SS - D
Coating VOC Content *	0 g/l	523 g/l	550 g/l	350 g/l
Material VOC Content	0 g/l	523 g/l	219 g/l	100 g/l
Solid Content (by Volume) **	25%	31%	13%	22%
Cost***	$26.99/gal	$33.96/gal	$21.65/gal	$18.97/gal

Table 4-1d Coating Comparisons – Interior Semi-Transparent Stain

	No-VOC Coating	Conventional Coating		
	STS - A	STS – B	STS - C	STS - D
Coating VOC Content *	0 g/l	485 g/l	720 g/l	300 g/l
Material VOC Content	0 g/l	330 g/l	120 g/l	45 g/l
Solid Content (by Volume) **	10%	19.3%	4%	6%
Cost***	$12.99/qt	$5.97/qt	$10.13/qt	$12.97/qt

* Coating VOC (g/l), excluding water and exempt compounds, reported from Manufacturer Product Data Sheet
Material VOC (g/l) from Manufacturer Product Data Sheet and telephone survey

** Solid content (by volume) reported from Manufacturer Product Data Sheet

*** Retailed price from store and telephone survey

Table 4-2a and 4-2b summarize the costs associated with replacing conventional coating systems with the new no-VOC coating system.

Table 4-2a Cost Comparison of Varnish Systems

	No-VOC Coating	Conventional Coating		
Varnish System	S1-A	S1-B	S1-C	S1-D
Top Coat ($/gal)	$42.99	$32.47	$29.60	$54.96
Sanding Sealer ($/gal)	$26.99	$33.96	$21.65	$18.97
Stain ($/qt)	$12.99	$5.97	$10.13	$12.97
Top Coat Usage[1] (gallon)	1.00	0.52	0.54	1.00
Sanding Sealer Usage[1] (gallon)	0.50	0.40	0.96	0.57
Stain Usage[1] (gallon)	0.25	0.13	0.63	0.42
Estimated System Usage (gallon)	1.75	1.05	2.12	1.98
Relative Usage vs. No-VOC Coating	1.00	0.60	1.21	1.13
System Price[2]	$69.48	$33.58	$62.00	$87.36
Relative Coating Cost [3]	100.00%	48.34%	89.24%	125.74%

Table 4-2b Cost Comparison of Lacquer Systems

	No-VOC Coating	Conventional Coating		
Lacquer System	S2-A	S2-B	S2-C	S2-D
Top Coat ($/gal)	$32.99	$29.97	$22.55	$29.97
Sanding Sealer ($/gal)	$26.99	$33.96	$21.65	$18.97
Stain ($/qt)	$12.99	$5.97	$10.13	$12.97
Top Coat Usage[1] (gallon)	1.00	1.02	2.07	1.00
Sanding Sealer Usage[1] (gallon)	0.50	0.40	0.96	0.57
Stain Usage[1] (gallon)	0.25	0.13	0.63	0.42
Estimated System Usage	1.75	1.55	3.66	1.98
Relative Usage vs. No-VOC Coating	1.00	0.89	2.09	1.13
System Price[2]	$59.48	$47.30	$92.91	$62.37
Relative Coating Cost [3]	100.00%	79.53%	156.22%	104.86%

Notes:

1 This usage estimate is based on solid content (by volume) of each coating compared with the solid content (by volume) of the no-VOC coating.

2 System cost is estimated by adding topcoat, sanding sealer, and stain costs for estimated system usage.

3 This cost estimate does not include the benefit of increased productivity. By switching to no-VOC coatings, the productivity is no longer limited by the coating process since the maximum number of products sprayed per day can increase.

This new coating system unit price (cost per gallon) is lower than the unit price of the hybrid system but higher than those of the solvent-based coating systems on the market. However, once all other long-term cost savings are factored in (no emission fees, and no disposal fees), this new coating system price is more attractive. In addition, productivity can be increased due to unlimited no-VOC coating usage (no VOC emissions permit ceiling for this new coating system). The successful side-by-side comparison and repair/refinishing tests, field demonstration, and cost comparison clearly demonstrate that this no-VOC wood coating system is a good alternative to other popular more polluting commercial wood coatings. By using this new, promising no-VOC water-based coating technology, significant reductions in air emissions, hazardous wastes, and health risk could be achieved. As the limits on VOC contents of lacquer,

varnish, sanding sealer, waterproofing sealer, opaque stain and semitransparent stain are reduced, there will be an increased incentive to manufacture this no-VOC coating system. This new technology is ready for large scale commercialization due to the availability of the resin RESILEX® , and competitive material costs, existing capital outlay capability, and reasonable labor costs.

4.2 Environmental Impact Assessment

The following sections focus primarily on the major environmental impacts (benefits) from replacing traditional solvent-based coatings with the new non-VOC coatings. Whenever possible, emission data available from the ARB and/or AQMD are used to quantify the environmental benefits resulting from employing this new non-VOC and non-HAPs coating technology. Using a "simplified" life-cycle assessment (LCA) methodology, the environmental impacts analysis accounts for differences in coatings impacts when compared to the new coating system. Impacts studied include:

- Air Quality Impacts
- Water Quality Impacts
- Waste Impacts
- Risks

In addition to the environmental benefits, the new no-VOC wood coating is in compliance with the current and future VOC limits of the AQMD Rule 1113 for architectural coatings.

4.2.1 Air Quality Impacts

Traditional coating technologies emit large quantities of air pollutants through the volatilization of organic solvents and carriers. These air pollutants include VOCs, HAPs, and ozone depleting compounds. VOCs react photochemically with oxides of nitrogen to form ozone, a reactive compound that irritates human tissue and causes damage to plant life. HAPs emitted from coatings affect health and safety of workers in the workplace and in surrounding areas. Ozone-depleting compounds deplete the stratosphere ozone layer, which protects life from solar UV radiation. Since traditional solvent-based coatings are widely used in many commercial and industrial facilities, the environmental benefit from the use of the new coatings is significant, especially in localized industrial areas in California, such as the South Coast Air Basin.

VOCs generated from the application, curing, handling and storage of coatings combine with nitrogen oxides, and combustion pollutants, to form ozone. Ozone causes shortness of breath, kills lung cells, and is suspected of causing premature aging of the lungs. VOCs also contribute to the formation of particulate pollution, or PM_{10}, which is linked to premature deaths in the South Coast Air Basin. Since homeowners and painting contractors like to paint during good weather, VOC emissions from architectural coatings are highest during summer, when ozone pollution is at its worst. Although the average VOC content in architectural coatings has fallen in recent years due to

environmental regulations, the total VOC emissions from architectural coatings are expected to increase in the South Coast Air Basin due to population and housing growth.

The development, demonstration and commercial use of zero-VOC coatings will result in a reduction of VOC emissions from the control measures stipulated in the 1999 AQMP. According to the 1999 ARB survey of 1996 coatings, the VOC emissions from these coatings are over 5 tons per day in the South Coast Basin. If new coating systems (less than 50 g/l) are successfully implemented, over 2.56 tons per day of further VOC emissions reduction from these new coating categories beyond potential reduction with future rule limit would be achieved..

4.2.2 Water Quality Impacts

Use of traditional coatings has the potential for ground water contamination due to the need for solvent thinning and cleanup. Also, the transportation of spent solvent on roads to distant Class I disposal facilities raises the risk of spills and potential exposure of nearby communities to environmental and health risks. Because the new non-VOC coatings do not generate solvent laden hazardous waste, the risk associated with ground water contamination would be eliminated.

4.2.3 Waste Disposal Impacts

There three potential sources of hazardous waste generation from the use of traditional solvent-based coatings- (1) the unused coating containing hazardous solvents, (2) spray booth filters contaminated with solvent-laden particulates, and (3) hazardous spent carbon from carbon adsorbers, if used to control the VOC emissions. Since the new coatings contain no VOCs and HAPs, the generation of hazardous wastes is eliminated, which contributes to environmental as well as coat benefits.

4.2.4 Risks

Use of traditional solvent-containing coatings may have the potential to expose workers and the surrounding community to health and safety risks. This is primarily due to the concentration of VOCs in the air-stream resulting from the coating application and/or during the handling, storage, and disposal of the solvent-laden waste material. The risks include human health, and fire/explosion risks.

4.2.4.1 Human Health Risk

The traditional organic solvent-based coatings contain VOCs of which many are HAPs. Human exposure to these HAPs is a potential human health risk. The greatest risk, based on potential exposure, would be to the coating application workers, followed by the plant workers, and finally the surrounding community. The potential human health risk can be determined following identification of HAPs in each coating and the estimate of potential exposure using the appropriate air dispersion models. Specialized personal

protection equipment (PPE) may be necessary to protect application workers and anyone else with a potential exposure to a concentrated VOC/HAP stream, e.g., spray booth exhaust stream. Replacing the solvent-based coatings with new coatings without HAPs can mitigate this human health risks.

4.2.4.2 Explosion/Fire Risk

Traditional solvent-based coatings contain flammable VOCs and pose a potential explosion/fire hazard. During application and drying in an enclosure, the risk is significantly greater due to the volatilization of the flammable solvents. In addition, waste material that contains residual VOCs (e.g., spray booth filters) remains a potential explosion/fire hazard and must be handled, stored, and disposed of according to flammable hazardous waste regulations. Facilities are required to maintain an emergency response management plan (such as a Fire Department Business Plan), and are also required to observe and maintain safety procedures in the work area.

These safety risks, and many administrative tasks associated with handling VOC-based coatings can be eliminated if the non-VOC coatings are substituted in the workplace.

SECTION 5 - CONCLUSION AND RECOMMENDATIONS

1. The goal of the project was to develop and demonstrate zero-VOC or low-VOC coatings (varnish, lacquer, stains, waterproof sealers and sanding sealers) to further reduce VOC emissions in the South Basin. The target in developing the coatings was to achieve a performance level equal to, or better than similar coatings currently used by the industry. Laboratory analysis confirmed that these new coatings formulated for this project have VOC contents of less than 10 g/l (calculated from GC/MS analysis results).

2. Most performance characteristics of this new no-VOC wood coating system (including adhesion, beading, chemical resistance, coating penetration, dirt pick-up, dry time, mar resistance, moisture vapor transmission, stain blocking, print resistance, swelling, water uptake, and overall appearance) are equivalent to those of commercial coatings based on the side-by-side comparative testing results. Advantages of these no-VOC coatings include better grain raising for varnish, less color change (for lacquer, varnish, and sanding sealer), better moisture/UV resistance for exterior semitransparent stain, and better water repellent efficiency for waterproofing sealer. However, the dry time, freeze/thaw properties, pot life, mildew/fungus resistance, printing resistance, and stain blocking properties of these no-VOC waterborne coatings are not as good as those of solvent-based coatings.

3. Three popular commercially available coating systems (both lacquer and varnish) were tested side-by-side with no-VOC lacquer and varnish topcoat systems for repair and refinishing. This new no-VOC varnish system showed the best overall appearance after repair, but had the highest coating usage because the two-component coating resulted in a limited pot life. The new no-VOC Lacquer system was the easiest to repair and showed the best gloss after repair.

4. In order to obtain the impartial opinion of experienced painters on the performance of the new coatings, the painters of Commercial Casework, Inc. in Fremont, California conducted a field demonstration of the new coating system as part of this study. The personnel from Commercial Casework were impressed with the new wood coatings due to fast dry time, ease of use, and the safer working environment resulting from the absence of solvents.

5. This new coating system unit price (cost per gallon) is lower than the unit price of the hybrid system, but higher than those of the solvent-based coating systems on the market. However, once all other long-term cost savings are factored in (no emission fees, and no disposal fees), this new coating system price is more attractive. In addition, with the elimination of VOC emissions ceiling, productivity can be increased due to unlimited no-VOC coating usage. Cumulative environmental impacts on this no-VOC coating system are insignificant, and no significant project-specific cost impacts are anticipated.

6. The development, demonstration and commercial use of zero-VOC coatings could potentially result in VOC emission reduction from the control measures in the 1999 AQMP. According to the 1999 ARB survey of 1996 coatings, the VOC emissions from the categories covered by this project are over 5 tons per day in the South Coast Basin. If new coating systems (less than 50 g/l) are successfully implemented, over 2.56 tons per day of further VOC emissions reduction from these new coating categories beyond potential reduction with future rule limit would be achieved. By using this new, promising no-VOC water-based coating technology, the anticipated air emissions reduction and health risk reduction could be achieved. Therefore, commercialization of the proposed technology will provide an alternative for compliance with current and future emission standards for coating operations imposed by federal, state, and local government agencies.

Appendix A

Side-by-side Comparison Testing Protocol

DEVELOPMENT AND DEMONSTRATION OF ZERO- AND LOW-VOC RESIN TECHNOLOGY FOR ADVANCED CONTROL MEASURE DEVELOPMENT

Final Test Protocol

Prepared for:

South Coast Air Quality Management District
21865 East Copley Drive
Diamond Bar, CA 91765

AQMD Contract #99143

Prepared by:

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A. SELECTED COATINGS FOR TESTING

A1. Lacquer (Clear Wood Finish)

Manufacturer	Lacquer
CWF-A	WLQ-6C
CWF-B	Polycrylic Clear Gloss
CWF-C	550 Crystaclear LQ 153-0
CWF-D	Aquazar Polyurethane Gloss

A2. Varnish

Manufacturer	Varnish
V-A	WTC-99
V-B	Wood Classics FastDry Polyurethane Gloss[1]
V-C	Heirloom Gloss [1]
V-D	MegaWaterborne [1]

A3. Exterior Opaque Stains

Manufacturer	Opaque Stain
EOS-A	WST-4
EOS-B	Cuprinol Solid Color [1]
EOS-C	6520 Series [1,2]
EOS-D	Acrylic Latex Stain [1]

A4.1 Exterior Semi-Transparent Stains

Manufacturer	Exterior Semi-Transparent Stain
ESTS-A	EXTSTSTN
ESTS-B	Wood Scapes A15T5 [1]
ESTS-C	6380 Series [1,2]
ESTS-D	Oil Stain Redwood #704

A4.2 Interior Semi-Transparent Stains

Manufacturer	Interior Semi-Transparent Stain
ISTS-A	WST-5 [3]
ISTS-B	Wood Finish Special Walnut
ISTS-C	Decolac II Stain LQ 122
ISTS-D	Diamond Wood Stain
ISTS-E	Stainseal II Walnut

A5. Sanding Sealers

Manufacturer	Sanding Sealer
SS-A	WSS-9D
SS-B	Wood Classic FastDry B26V43 [1]
SS-C	Crystaclear LQ 150-0
SS-D	Pro Finisher Waterborne

A6. Waterproofing Sealers

Manufacturer	Water Proofing Sealer
WS-A	WPS-2
WS-B	Water Proofing Sealer (Water Based) [4]
WS-C	Waterseal Ultra [4]
WS-D	#92 Water Proofing Clear

A7. System #1

Manufacturer	Stain	Sanding Sealer	Varnish
S1-A	WST-5	WSS-9D	WTC-99
S1-B	Wood Finish # 224	Wood Classics FastDry Sanding	Wood Classics FastDry Polyurethane
S1-C	StainSeal II	Pro Finisher Sealer # 13-7163 [5]	Heirloom Varnish
S1-D	Diamond Wood Stain	Pro Finisher Sealer # 13-7163	Mega Waterborne Finish

A8. System #2

Manufacturer	Stain	Sanding Sealer	Lacquer (2 Coat)
S2-A	WST-5	WSS-9D	WLQ-6C
S2-B	Wood Finish # 224	Wood Classics FastDry Sanding	Polycrylic Clear Gloss
S2-C	Decolac II LQ 122	550 Crystaclear LQ 150-0	550 Crystaclear LQ 153-0
S2-D	Diamond Wood Stain	Pro Finisher Sealer # 13-7163	Aquazar Waterborne Urethane

A9. System #3

Manufacturer	Stain	Sanding Sealer	Lacquer (3 Coat)
S3-A	WST-5	WSS-9D	WLQ-6C
S3-B	Wood Finish # 224	Wood Classics FastDry Sanding	Polycrylic Clear Gloss
S3-C	Decolac II LQ 122	550 Crystaclear LQ 150-0	550 Crystaclear LQ 153-0
S3-D	Diamond Wood Stain	Pro Finisher Sealer # 13-7163	Aquazar Waterborne Urethane

Note:

1. Selected from manufacturers according to their VOC compliance specifications.
2. Selected based on product's availability.
3. ADCO's WST-5 will be used for interior testing only. ADCO's semi-transparent stain will be reformulated as EXTSTSTN and tested for exterior use.
4. Selected from the CARB "Suggested Control Measure for Architectural Coatings" February 2000 issue.
5. This manufacturer does not have a sanding sealer for Varnish.

B. TESTS FOR INDIVIDUAL NEW & COMPARATIVE COATINGS

Test methods and descriptions of each parameter are described below:

B1. Lacquer

Wet Film Thickness – ASTM D1212

Dry Time – ASTM D 1640
- Set to touch
- Tack free
- Dry through
- Dry hard
- Recoat time

Grain Raising

Freeze/Thaw (For waterborne only) - ASTM D2243

Orange Peel

Printing Resistance – ASTM D2091

Gloss – ASTM D523

Adhesion (Parallel Groove Adhesion) – ASTM D3359

Appearance
- Flow Problems
- Color
- Depth
- Color Change - ASTM D2244
- Hot/Cold Check - ASTM D1211
- Sprayability
- Leveling/Sagging

B2. Varnish

Wet Film Thickness – ASTM D1212

Dry Time – ASTM D 1640
- Set to touch
- Tack free
- Dry through
- Dry hard

Recoat time

Grain Raising

Freeze/Thaw (For waterborne only) - ASTM D2243

Orange Peel

Printing Resistance – ASTM D2091

Gloss – ASTM D523

Adhesion (Parallel Groove Adhesion) – ASTM D3359

Appearance
- Flow Problems
- Color
- Depth
- Color Change - ASTM D2244
- Hot/Cold Check - ASTM D1211
- Sprayability
- Leveling/Sagging

B3. Exterior opaque stains

Dry Time – ASTM D 1640
- Set to touch
- Tack free
- Dry through
- Dry hard

Grain Raising

Freeze/Thaw (For waterborne only) - ASTM D2243

Penetration into Substrate – Observe the depth of stain penetrating to the substrate at the cross section.

Stain Blocking – Calcoast [6] Method

Mildew/Fungus Resistance – ASTM D3273-94

Dirt Pickup – Carbon Black Method

Color Change - ASTM D2244

UV Resistance (G53) – ASTM G53-88

Moisture Resistance – Combined with UV Resistance

B4.1 Semi-transparent stains (Exterior)

Dry Time – ASTM D 1640
- Set to touch
- Tack free
- Dry through
- Dry hard

Grain Raising

Freeze/Thaw (For waterborne only) - ASTM D2243

Penetration into Substrate – Observe the depth of stain penetrating to the substrate at the cross section.

Stain Blocking – Calcoast [6] Method

Mildew/Fungus Resistance – ASTM D3273-94

Dirt Pickup – Carbon Black Method

Color Change - ASTM D2244

Appearance – ASTM G53-88

B4.2 Semi-transparent stains (Interior)

Dry Time – ASTM D 1640
- Set to touch
- Tack free
- Dry through
- Dry hard

Grain Raising

Freeze/Thaw (For waterborne only) - ASTM D2243

Finish

Grain Definition

Application Method

B5. Sanding sealers

Dry Time – ASTM D 1640
- Set to touch
- Tack free
- Dry through
- Dry hard
- Recoat time

Grain Raising

Freeze/Thaw (For waterborne only) - ASTM D2243

Appearance
- Flow Problems
- Color
- Depth
- Color Change - ASTM D2244
- Hot/Cold Check - ASTM D1211
- Sprayability
- Leveling/Sagging
- Sandability

B6. Waterproofing sealers (wood substrate)

Freeze/Thaw – ASTM D2243

Moisture Vapor Transfusion - ASTM D 1653

Water Repellent Efficiency – ASTM D5401

Swelling - ASTM D4446

Water uptake

B7. Waterproofing sealers (concrete/masonry)

Freeze/Thaw – ASTM D2243

Moisture Vapor Transfusion - ASTM D 1653

Beading – Document how well water beads on the coating surface.

Coating Penetration

B8. Tests for systems

System #1 Semi - Transparent Stain (Interior)/Sanding Sealer/Varnish

System#2 Semi – Transparent Stain (Interior)/Sanding Sealer/Lacquer (2 Coats)

System#3 Semi – Transparent Stain (Interior)/Sanding Sealer/Lacquer (3 Coats)

Scrape/Mar Resistance – ASTM D2197

Wet Film Thickness – ASTM D1212

Color Change - ASTM D2244-73

Household Chemical Resistance (Specify chemicals & stains) – ASTM D1308

Pencil Hardness after 2 weeks ambient cure – ASTM 3363

Parallel Groove Adhesion – ASTM D3359

Printing resistance – ASTM D2091-88

Appearance
Depth
Orange Peel
Gloss 60° - ASTM D523-89

Note:

6. The following is the test method used by Calcoast to evaluate the ability coatings to resist stain bleed-through from a wood substrate.
   - Redwood and rough cedar panels (0.5" x 3" x 4") are coated on both sides (applying a new exterior stain on one side of the panel and a corresponding selected stain on the opposite side of the same panel) and allowed to cure as per the manufacturer's recommendations (minimum 1 week cure time allowed).
   - Prepared panels are placed in a humidity chamber which is maintained at a constant 100 °F and a minimum 95% Relative Humidity (saturation).
   - All samples are evaluated on a weekly basis. Evaluation is by visual inspection, supplemented with microscopic examination as necessary (e.g. to distinguish between stain bleed-through and exposure related surface discoloration).

C. SUBSTRATE

Testing will be conducted on 2 different panels for each test:

- Oak and maple are proposed for interior coating.
- Rough cedar and redwood are proposed for exterior opaque stains/exterior semi-transparent stains
- Concrete/masonry, rough cedar, and redwood are proposed for waterproofing sealers

Appendix B

Side-by-side Comparison Testing Results

Category A1 - Clear Wood Finish (CWF)

Manufacturer	Trade name	Reported V.O.C, / (g/l) type	ASTM D1212 Wet film thickness (mils)	Recoat time label claim	ASTM D1640 Dry times on sealed charts at 3 mils wet film				Grain raising*a	ASTM D2243 Freeze-Thaw	Orange peel		ASTM D2091 Printing resistance		ASTM D523 Gloss 60 degree		ASTM D3359 Adhesion		Appearance[3]					Sprayability		Sag (0-12, 12-best)
					Set to touch	Tack free	Dry through	Dry hard	Amount Birch plywood (0 – 5, 5-best)	Resistance-cycles (0-5, 5-best)	Oak	Maple	Oak (0-3, 3-best)	Maple (0-3, 3-best)	Oak (0-100)	Maple (0-100)	Oak (0-5, 5-best)	Maple (0-5, 5-best)	Flow (0-5, 5-best)	Color	Depth	Color change ASTM D2244 (unit ΔE 0-best)	ASTM D1211 Hot/cold check (cycles)	Rating	Equipment	
CWF-A*	WLQ-6C	0 w/b[1]	3	2 hr	34 min	37 min	1.5 hr	2 hr	2	2	No	No	2	2	56	74	5B	5B	5	Light color	Excellent	3.92	Pass 6 cycles	Very good	Cup gun Binks #2001	<3 mils
CWF-B	Polycrylic Clear Gloss	350 w/b	3	2 hr	33 min	40 min	1.5 hr	2 hr	2	5	No	No	2	2	67	77	4B	2B	5	Light color	Foam problem	4.88	Pass 6 cycles	Very good	Cup gun Binks #2001	<3 mils
CWF-C	550 Crystaclear Gloss Lacquer LQ153-0	548 s/b[2]	3	45 min	7 min	15 min	20 min	20 min	2	N/A[2]	No	No	3	3	47	68	5B	5B	4	Light color	Lots of passes for 1 mil dry	5.23	Fail 5	Very good	HVLP Binks BBR	7 mils
CWF-D	Aquazar waterborne polyurethane Gloss	328 w/b	3	2 hr	30 min	35 min	1.5 hr	2 hr	2	5	No	No	2	2	47	67	5B	5B	5	Light color	Excellent	6.85	Fail 4	Very good	Cup gun Binks #2001	<3 mils

[1] Waterborne. [2] Solvent-based. [3] No blistering, cracking, flakiness observed during test.
*a- refer to Summary of Non-standard Test Methods *- No-VOC coating

Category A2 – Varnish (V)

Manufacturer	Trade name	Reported V.O.C, / (g/l) type	ASTM D1212 Wet film thickness (mils)	Re-coat time label claim	ASTM D1640 Dry times on sealed charts at 3 mils wet film				Grain raising	ASTM D2243 Freeze-Thaw	Orange peel		ASTM D2091 Printing resistance		ASTM D523 Gloss 60 degree		ASTM D3359 Adhesion		Appearance[4]					Sprayability		Sag (0-12, 12-best)
					Set to touch	Tack free	Dry through	Dry hard	Amount Birch plywood (0 – 5, 5-best)	Resistance-cycles (0-5, 5-best)	Oak	Maple	Oak (0-3, 3-best)	Maple (0-3, 3-best)	Oak (0-100)	Maple (0-100)	Oak (0-5, 5-best)	Maple (0-5, 5-best)	Flow (0-5, 5-best)	Color	Depth	Color change ASTM D2244 (unit ΔE 0-best)	ASTM D1211 Hot/cold check (cycles)	Rating	Equip ment	
V-A*	WTC-99	0 w/b[1]	4	3 hr	1 hr	1.25 hr	6 hr	6 hr	4	N/A[3]	No	No	3	3	63	75	5B	5B	4	Light color	Not sharp as image	5.71	Pass 6 cycles	Very good	Cup gun Binks #2001	7 mils
V-B	Fast Drying Polyurethane gloss	450 s/b [2]	3	4 hr	50 min	1.5 hr	2 hr	2.5 hr	2	N/A[2]	No	No	3	3	84	88	1B	0B	5	Low color	Excellent image	24.1	Pass 6 cycles	Very good	HVLP Binks BBR	< 3 mils
V-C	Heirloom Gloss Varnish	350 s/b	4.5	16 hr	1 hr	5 hr	6.25 hr	9 hr	2	N/A[3]	No	No	3	1	86	91	5B	5B	5	Quite amber	Sharp gloss	21.26	Pass 6 cycles	Very good	HVLP Binks BBR	< 3 mils
V-D	Mega Waterborne	250 w/b	3	3 hr	30 min.	35 min.	1.5 hr	2 hr	2	5	No	No	3	3	54	83	5B	5B	5	Light color	Lower build low color	9.27	Pass 6 cycles	Very good	Cup gun Binks #2001	< 3 mils

[1] Waterborne. [2] Solvent-based. [3] Two components coating. [4] No blistering, cracking, flakiness observed during test.
*- No-VOC coating

Category A3 - Exterior Opaque Stains (EOS)

Manufacturer	Trade name	Reported V.O.C, (g/l), type	ASTM D1640 Dry times on sealed charts at 3 mils wet film				Grain raising*a	ASTM D2243 Freeze-Thaw	Coating Penetration Cedar / Redwood unit 1/1000 inch*b	Stain blocking rating*c (0-4, 4-best) [3]				ASTM 3273-94 Mildew / Fungus Resistance (0-10, 10-best) [3]				Dirt pick-up rating (0-5, 5-best)	Color change ASTM D2244 (unit ΔE, 0-best) Redwood/Cedar	ASTM G53-88 [4,5] Appearance(0-5, 5-best) Redwood/cedar
										Extent		Severity		Week No.						
			Set to touch	Tack free	Dry through	Dry hard	Amount (0 – 5, 5-best) Wood Smooth cedar	Resistance-cycles (0-5, 5-best)		redwood	cedar	redwood	cedar	1	2	3	4			
EOS-A*	WST-4 (EXTOPSTN)	0 w/b [1]	2 hr	2 hr	3 hr	3 hr	3	1	4.7 / 5.7	2/2	4/4	3/3	4/4	8/10	6/10	6/6	4/4	2	0.52/1.58	5/4
EOS-B	Cuprinol Solid Color Deck Stain	96 before tint	15 min	25 min	40 min	40 min	3	5	1.9 / 4.7	2/2	4/4	3/4	4/4	10/10	10/10	8/10	6/8	2	0.35/6.33	5/4
EOS-C	O.V.T Solid Color Oil Stain Tile Red #6520	< 350 s/b [2]	1 hr	4 hr	7 hr	8 hr	3	N/A[2]	5.7 / 6.6	2/2	4/4	4/4	3/4	10/10	10/10	10/10	10/10	3	2.76/6.28	1/3
EOS-D	Premium Acrylic Latex Stain Solid Color Navajo Red #59660	76.8 w/b	15 min	20 min	45 min	1.25 hr	3	5	2.8 / 2.8	4/3	1/4	3/4	3/4	8/10	6/8	4/6	2/4	3	0.79/2.41	5/5

[1] Waterborne. [2] Solvent-based. [3] Duplicates [4] No cracking or peeling observed during the time period. [5] Moisture resistance was combined with UV resistance test.

*a, *b, *c - refer to Summary of Non-standard Test Methods. *- No-VOC coating

Category A4.1 – Exterior Semi Transparent Stains (ESTS)

Manufacturer	Trade name	Reported V.O.C, /(gm/l) type	ASTM D1640 Dry times on sealed charts at 3 mils wet film				Grain raising*a	ASTM D2243 Freeze-Thaw	Coating Penetration Cedar / Redwood unit 1/1000 inch	Stain blocking rating (0-4, 4-best)[3]				ASTM 3273-94 Mildew / Fungus Resistance (0-10, 10-best) [3]				Dirt pick-up rating *d (0 – 5, 5-best)	Color change ASTM D2244 (unit ΔE, 0-best) Redwood/Cedar	ASTM G53-88 [4, 5] Appearance (0 –5, 5-best) Redwood/cedar
			Set to touch	Tack free	Dry through	Dry hard	Amount (0 – 5, 5-best) Wood Smooth cedar	Resistance-cycles (0-5, 5-best)		Extent		Severity		Week No.						
										redwood	cedar	redwood	cedar	1	2	3	4			
ESTS-A*	EXTSTSTN	0 w/b[1]	20 min	20 min	1 .5 hr	1 .5 hr	3	1	4.7 / 4.7	2/2	2/2	1/1	2/2	10/10	8 / 10	6 / 8	5 / 7	2	1.33/2.8	4/4
ESTS-B	Woodscapes A15T5 (tinted redwood)	475 w/b	30 min	40 min	1 hr	1 .5 hr	3	5	3.8 / 4.7	3/3	4/4	3/2	4/4	10/10	8 / 10	8 / 10	8 / 8	2	5.05/6.26	3/3
ESTS-C	Semitransparent stain #6380 redwood	< 350 s/b[2]	Over-night	Over-night	Over-night	2 days	3	N/A	7.6 / 10.4	2/2	1/1	2/2	2/2	10/10	10 / 10	10 / 10	10 /10	2	6.51/3.38	3/3
ESTS-D	Water Repellent Oil Stain S/T redwoood #704	< 350 s/b	Over-night	Over-night	Over-night	Overn ight	3	N/A	9.5 / 14.2	2/2	1/1	2/2	2/2	10/10	8 / 10	8 / 10	9 / 7	3	5.68/2.4	3/3

[1] Waterborne. [2] Solvent-based. [3] Duplicates [4] No cracking or peeling observed during the time period. [5] Moisture resistance was combined with UV resistance test.
*a, *d – refer to Summary of Non-standard Test Methods. *- No-VOC coating

Category A4.2 – Interior Semi Transparent Stains (ISTS)

Manufacturer	Trade name	Reported V.O.C, / (g/l), type	ASTM D1640 Dry times on sealed charts at 3 mils wet film				Grain raising*a	ASTM D2243 Freeze-Thaw	Finish (oak/maple)	Grain definition (oak/maple)	Application method (oak/maple)
			Set to touch	Tack free	Dry through	Dry hard	Amount (0 – 5, 5-best) Wood Smooth cedar	Resistance-cycles (0-5, 5-best)			
ISTS-A*	WST-5	0 w/b[1]	10 min	10 min	40 min	40 min	4	5	Reddish brown/ Reddish brown	Good grain definition/ Good grain definition	Wiping / Wiping
ISTS-B	Wood Finish Special Walnut # 224	485 s/b	6 hr	7 hr	7 hr	8 hr	4	N/A[2]	Dark brown/ Dark brown	Very good grain definition/ Very good grain definition, some blotchiness	Wiping / Wiping
ISTS-C	Decolac II lacquer stain LQ 122 FRENCH PEARL	< 720 s/b	15 min	21 min	26 min	26 min	4	N/A[2]	Light brown with white accents/ Light brown with white accents	Less definition/ Less definition	Spray/ spray
ISTS-D	Diamond Wood Stain Special Walnut	300 w/b	45 min	1 hr	2 hr	3 hr	4	5	Brown/Light brown	Very good grain definition/ Good grain definition	Wiping / Wiping
ISTS-E	Stainseal II wiping oil stain walnut	< 550 s/b[2]	6 hr	7 hr	7 hr	8 hr	5	N/A[2]	Yellowish brown/ Yellowish brown	Very good grain definition/ Very good grain definition	Wiping / Wiping

[1] Waterborne [2] Solvent-based. *a – refer to Summary of Non-Standard Test Methods *- No-VOC coating

Category A5- Sanding Sealers (SS)

Manufacturer	Trade name	Reported V.O.C. / (g/l) type	Re-coat time label claim	ASTM D1640 Dry times on sealed charts at 3 mils wet film				Grain raising*a	ASTM D2243 Freeze-Thaw	Color change ASTM D2244 (unit ΔC/E, 0-best)	Flow	Sandability	ASTM G53-88 Appearance	ASTM D1211 Hot/cold check (cycles)	Sprayability		Sag (3 –12 mils, 12-best)
				Set to touch	Tack free	Dry through	Dry hard	Amount (0 – 5, 5-best) (Wood-Oak)	Resistance-cycles (0-5, 5-best)						Rating	Equipment	
SS-A*	WSS-9D	0 w/b[1]	1 hr	30 min	50 min	1 hr	1 hr	3	5	4.43	Excellent	Okay	Some loading	N/A	Very good	Cup gun Binks #2001	< 3 mils
SS-B	Wood Classic FastDry B26V43	522 s/b[2]	1 hr	25 min	35 min	45 min	45 min	4	N/A	9.86	Excellent	Best	Easy powder	N/A	Very good	HVLP Binks BBR	3 mils
SS-C	550 Crystaclear Lacquer sanding sealer LQ 150-0	< 550 s/b	45 min	15 min	15 min	20 min	20 min	3	N/A	4.92	Excellent	Good sanding	Lots of passes for 1 mil dry	N/A	Very Good	HVLP Binks BBR	6 mils
SS-D	Pro Finisher Waterborne	< 350 w/b	2 hr-w/b 12 hr- s/b	30 min	1 hr	1 hr	1 .5 hr	3	5	6.93	Excellent	Good sanding	Slight loading	N/A	Very Good	Cup gun Binks #2001	< 3 mils

[1] Waterborne [2] Solvent-based. *- No-VOC coating
*a, – refer to Summary of Non-standard Test Methods.

Category A6- Waterproofing Sealer (WS)

Manufacturer	Trade name	Reported V.O.C. / (g/l), type	Wood and Concrete		Wood			Concrete	
			ASTM D2243 Freeze-Thaw Resistance-cycles	ASTM D1653 Moisture vapor transmission (0-500, 0-best)	ASTM D5401 Water repellent efficiency (%) (0 – 100, 100-best)[1]	ASTM D4446 Swell(%) (0 – 100, 0-best)	Water uptake(%)(0 – 100, 0-best)	Beading [3] (0 – 5, 5-best)	Coating penetration Sahtilo (unit 1/1000 inch, 1-best)
WS-A*	WPS-2	0 w/b[1]	0	38.8	87.4	0.42	1.85	> 4 hr	5
WS-B	Waterproofing sealer	< 8 w/b	1	352.63	49.2	0.74	2.4	> 4 hr	24
WS-C	Waterseal Ultra waterproofer	< 400 w/b	0	372.00	49.5	0.29	3.39	3 min	18
WS-D	#92 NWF WATERPROOFING Clear	< 350 s/b[2]	N/A	32.43	72.0	0.19	0.91	> 4 hr	45

[1] Waterborne [2] Solvent-based. [3] Time for five drops of water per bead without wetting the surface.
*- No-VOC coating

Category A7- System 1 (S1)

Manufacturer	Stain / Sanding Sealer /Varnish - 2 coats	ASTM D2197 Mar Resistance(grams) (higher is better)	ASTM D1212 Wet film thickness(mils)	ASTM D2244-73 Color Change			ASTMD1308 Household Chemical Resistance (0-5, 5-best)							ASTM 3363 Pencil hardness oak (5B-5H, 5H-hardest)	ASTM 3363 Pencil hardness maple (5B-5H, 5H-hardest)	ASTM D3359 adhesion oak(0B-5B, 5B-best)	ASTM D3359 adhesion maple(0B-5B, 5B-best)	ASTM D2091-88 Print resistance oak	ASTM D2091-88 Print resistance maple	Appearance [2]			
																				Depth	Orange Peel	ASTM D523-89 60 deg. Gloss oak	ASTM D523-89 60 deg. Gloss maple
				L*(oak/maple)[1]	a* (oak/maple)[1]	b*(oak/maple)[1]	D.I.water 16 hrs covered	Windex amm- d 1hr cvr	Expresso 1 hour covered	French's mustard 1 hour	Vodka 80 proof 1 hour cvrd	Axle grease 1 hour	Motor oil 1 hour							Oak/ Maple	Oak/ Maple		
S1-A*	WST-5 / WSS-9D / WTC-99	220	8	50.54/ 56.62	16.25/ 15.47	23.25/ 22.42	5	5	5	4	4	5	5	5H	>5H	5B	5B	No effect	No effect	Excellent/ Excellent	No/ No	63	75
S1-B	Wood Finish # 224 / Classic Fast Dry Sanding Sealer / Fast Drying Polyurethane	220	7	49.35/ 45.35	11.85/ 9.61	23.15/ 21.34	5	5	5	2	5	5	5	2B	2B	1B	0B	No effect	No effect	Excellent/ Excellent	No/ No	84	88
S1-C	Stainseal II/ Pro Finisher sanding sealer # 13-7163 / Heirloom Varnish	200	9	51.95/ 63.64	15.78/ 10.79	30.06/ 37.56	5	5	5	2	5	5	5	HB	2H	5B	5B	No effect	Medium	Excellent/ Eexcellent	No/ No	86	91
S1-D	Diamond wood stain / Pro Finisher S/S #13-7163 / Mega waterborne finish	180	7	53.25/ 62.15	11.8/ 8.74	22.2/ 21.22	3	1	3	2	3	5	5	5H	>5H	5B	5B	No effect	No effect	Excellent/ Excellent	No/ No	54	83

[1] L*, a*, b* are the coordinates descriptive of a color in Hunter Lab color space. This is a refinement of color theory to describe a color by its position in a 3 dimensional color space.
L* is the whiteness index. 0 is black and 100 is pure white. a* is the red-green axis (higher number is more red and lower number is more green). b* is the yellow-blue axis (higer number is more yellow and lower number is more blue).
[2] No grain raising, no flow problems, no blistering, no cracking, no flakiness observed. *- No-VOC coating

Category A8- System 2 (S2)

Manufacturer	Stain / Sanding Sealer / Lacquer - 2 coats	ASTM D2197 Mar Resistance(grams)	ASTM D1212 Wet film thickness (mils)	ASTM D2244-73 Color			ASTMD1308 Household Chemical Resistance (0-5, 5-best)							ASTM 3363 Pencil hardness oak (5B-5H, 5H-hardest)	ASTM 3363 Pencil hardness maple (5B-5H, 5H-hardest)	ASTM D3359 adhesion oak(0B-5B, 5B-best)	ASTM D3359 adhesion maple(0B-5B, 5B-best)	ASTM D2091-88 Print resistance oak	ASTM D2091-88 Print resistance maple	Appearance [2]			
																				Depth	Orange Peel	ASTM D523 60 deg. Gloss oak	ASTM D523 60 deg. Gloss maple
				L*(oak/maple)[1]	a* (oak/maple)[1]	b*(oak/maple)[1]	D.I.water 16 hrs covered	Windex amm- d 1hr cvr	Expresso 1 hour covered	French's mustard 1 hour	Vodka 80 proof 1 hour cvrd	Axle grease 1 hour	Motor oil 1 hour							Oak/ Maple	Oak/ Maple		
S2-A*	WST-5 / WSS-9D / WLQ-6C	200	7	51.18/ 52.67	16.00/ 16.80	21.61/ 21.72	3	1	3	2	2	5	5	> 5H	> 5H	5B	5B	Trace	Trace	Excellent/ Excellent	No/ No	56	74
S2-B	Wood Finish # 224 / Classic Fast Dry Sanding Sealer / Polycrylic Protective Finish	150	7	69.25/ 62.34	6.48/ 8.59	20.77/ 23.54	5	5	5	2	5	5	5	HB	F	4B	2B	Trace	Trace	Excellent/ Excellent	No/ No	67	77
S3-C	Decolac II lacquer stain #LQ122 / 550 Crystclear LQ 150-0 Sanding Sealer / 550 Crystaclear LQ 153-0	470	8	55.93/ 55.19	11.02/ 13.22	17.61/ 20.83	5	5	5	2	5	5	5	>5H	>5H	5B	5B	Trace	Trace	Good Good	Yes Yes	47	67
S4-D	Diamond wood stain / Pro Finisher S/S # 13-7163 / AQUAZAR waterborne urethane	180	7	51.73/ 54.72	10.77/ 11.64	19.82/ 19.98	3	1	3	2	3	5	5	> 5H	> 5H	5B	5B	None	None	Excellent/ Excellent	No/ No	47	68

[1] L*, a*, b* are the coordinates descriptive of a color in Hunter Lab color space. This is a refinement of color theory to describe a color by its position in a 3 dimensional color space.
L* is the whiteness index. 0 is black and 100 is pure white. a* is the red-green axis (higher number is more red and lower number is more green). b* is the yellow-blue axis (higher number is more yellow and lower number is more blue).
[2] No grain raising, no flow problems, no blistering, no cracking, no flakiness observed. *- No-VOC coating

Category A9- System 3 (S3)

Manufacturer	Stain / Sanding Sealer / Lacquer - 3 coats	ASTM D2197 Mar Resistance(grams)	ASTM D1212 Wet film thickness(mils)	ASTM D2244-73 Color Change			ASTMD1308 Household Chemical Resistance (0-5, 5-best)							ASTM 3363 Pencil hardness oak (5B-5H, 5H-best)	ASTM 3363 Pencil hardness maple (5B-5H, 5H-best)	ASTM D3359 adhesion oak(0B-5B, 5B-best)	ASTM D3359adhesion maple(0B-5B, 5B-best)	ASTM D2091-88 Print resistance oak	ASTM D2091-88 Print resistance maple	Appearance [2]			
				L*(oak/maple)[1]	a* (oak/maple)[1]	b*(oak/maple)[1]	D I water 16 hrs covered	Windex amm- d 1hr cvr	Expresso 1 hour covered	French's mustard 1 hour	Vodka 80 proof 1 hour cvrd	Axle grease 1 hour	Motor oil 1 hour							Depth	Orange Peel	ASTM D523 60 deg. Gloss oak	ASTM D523 60 deg. Gloss maple
																				Oak/ Maple	Oak/ Maple		
S3-A*	WST-5 / WSS-9D / WLQ-6C	200	9	47.29/ 53.3	16.08/ 16.82	18.96/ 22.31	3	1	3	2	2	5	5	> 5H	> 5H	5B	5B	None	None	Excellent/ Excellent	No/ No	64	74
S3-B	Wood Finish# 224 / Classic FastDry Sanding Sealer / Polycrylic Protective Finish	150	9	51.64/ 52.97	10.32/ 10.26	19.37/ 22.96	2	2	3	2	3	5	5	HB	HB	4B	0B	None	Trace	Excellent/ Excellent	No/ No	71	80
S3-C	Decolac II lacquer stain #LQ122 / 550 Crystclear LQ 150-0 Sanding Sealer / 550 Crystaclear LQ 153-0	270	10	56.89/ 60.33	11.87/ 10.78	18.7/ 18.22	5	1	3	2	2	5	5	4H	5H	5B	5B	None	None	Good Good	Yes/ Yes	78	76
S3-D	Diamond wood stain / Pro Finisher S/S # 13-7163 / AQUAZAR waterborne urethane	180	9	51.67/ 60.62	11.42/ 9.58	21.71/ 20.71	3	5	3	5	2	3	5	> 5H	> 5H	5B	5B	None	None	Excellent/ Excellent	No/ No	71	61

[1] L*, a*, b* are the coordinates descriptive of a color in Hunter Lab color space. This is a refinement of color theory to describe a color by its position in a 3 dimensional color space.
L* is the whiteness index. 0 is black and 100 is pure white. a* is the red-green axis (higher number is more red and lower number is more green). b* is the yellow-blue axis (higher number is more yellow and lower number is more blue).
[2] No grain raising, no flow problems, no blistering, no cracking, no flakiness observed. *- No-VOC coating

Summary of Non-standard Test Methods

Grain raising: Grain raising is a result of how wet the substrate becomes and how much coating is applied to the raw substrate.

Coating penetration: The panels that were coated for the respective test were cut. The cut was stained with a mixture of blue food color and water. The films do not absorb the color and this non-stained layer was measured with an optical microscope with a measuring reticule. The best definition of the layer occurs if the stain is applied while viewing the cross-section under the microscope. The penetration is expresed as divisions of the scale in the reticule. The penetration on the 2"x4" boards used for the water repellent efficiency test was looked at using this method. The results were to inconsistent to recommend these results or this method on these boards.

Stain blocking: Coated redwood panels were placed in a humidity chamber maintained at 100°F and a minimum 95% Relative Humidity (saturation) for four (4) weeks. A visual evaluation of the staining coming through the coatings from the substrate was performed.

Dirt Pick-Up: Carbon black was rubbed into the coated wood surface using moderate thumb pressure. The coating was then washed with a spooge and clean water, again using moderate pressure. Panels were evaluated after air drying.

Hot/cold check: These tests were run on panels of coatings that were dried for 3 weeks. The wood was a 5/8" birch cabinet grade plywood, 5 ply, all cut from the same sheet. No filler was used, films were applied by spray with their respective methods. The panels were prepared in duplicates. The cold box used was a refrigerator aided by dry ice to drop the temperature to sub zero. The average temperature on the cold cycle was -11°F to -2°F. the film thickness in mils were WTC-99 8 mils; WLQ-9C 7 mils; AQUAZAR 7 mils; BonaKemi MEGA 8 mils; D.E. LQ 153-0 9-10 mils; Minwax Polycrylic 7 mils; Heirloom varnish 12 mils; minwax Polyurethane 10 mils.

Mar resistance: This was performed using a loaded beam apparatus with a #13 steel yarn needle as marking tool. Here the tool is held at a 45 ° angle to surface, and the beam is loaded with weight until a permanent mark is made when moving across the surface of the panels. For this measurement, the system 2 and 3 films over maple were used as panels. The films had dried 4 weeks and the marks were made cross-grain.

Sandibility: Rating on how panels sanded with 150 grit sandpaper. The ratings noted; how quickly the films were leveled, sanding powder formed, filling of the grit of the sandpaper, and potential for gumming of the sandpaper. Both hand mechanical sanding was done.

Saltillo tiles: The 12"x12" tiles were selected for uniformity with set. The dust was brushed off the top surface and the water repellent applied with a brush until the tile would accept no more and a wet film of repellent was on the surface for more than one minute. The amount of repellent used was determined by weight applied. Dividing the amount used on the square foot tile by the weight per gallon gives the actual usage rate.

Moisture Vapor Transmission per ASTM D1653 (modified): Testing was performed on Whatman No. 4 Filter Papers impregnated with each of the coatings. Samples were tested after air drying for 1 week and conditioning to constant weight. Testing was performed on Whatman No.4 Filter Papers impregnated with 6g (wet) of each of the coatings. Controls were impregnated with water. A second set of samples were prepared for Coating B using just 3g of wet material. These were used in the testing as the original samples did not "dry" within the time frame for the test. Samples were tested after air drying for 1 week and conditioning to constant weight.

Appendix C

Photographs from Repair Tests

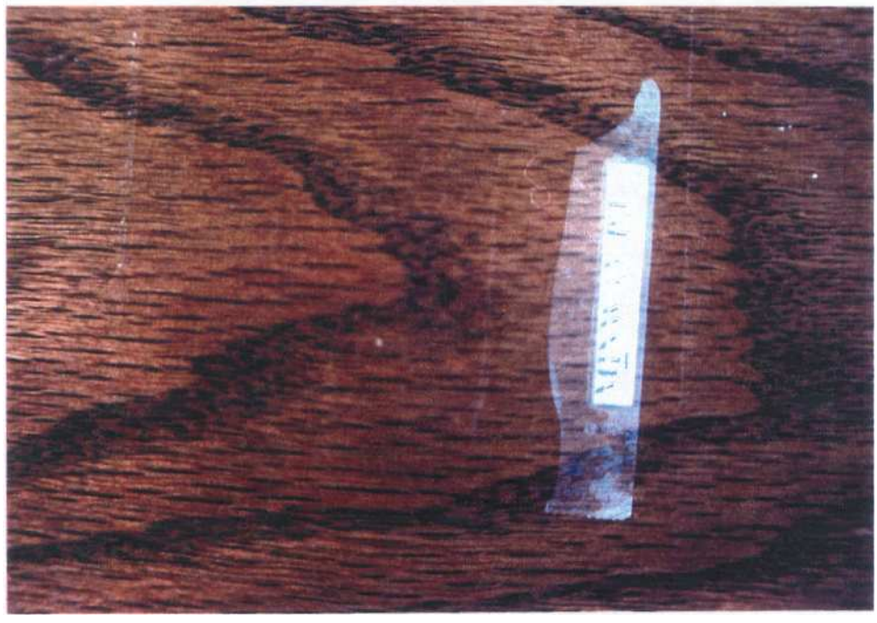
S1 **A** Original

S1 **A** Damaged

S1 **A** Repaired

S1 B Original

S1 B Damaged



S1 B Repaired

1 C Origi

C D maged

C Repa red

S1 D Original

S1 D Damaged

S1 D Repaired

S2 **A** Original

S2 **A** Damaged

S2 **A** Repaired

S2 B Original

S2 B Damaged

S2 B Repaired

S2 C Original

S2 C Damaged

S2 C Repaired

S2 – D Original

S2 – D Damaged

S2 – D Repaired

Appendix D

Field Demonstration Forms

South Coast Air Quality Management District Field Demonstration

Product Performance Form

12/13/00

Present: Rich Hosman, Jeff Wong, Guillermo Garcia

Name: Commercial Casework

System Description (Resin type, etc.): Sanding Sealer, Acrylic Lacquer, Urethane

Background (To do this job, what type (brand) of product would you typically use?: AMT Sealer, AMT Lacquer, AMT "A" Series Stain - All individually 450 g/L VOC, solvent-based with exempt solvents.

Facility Description: At a woodworking and coating facility. Typical output includes: conference tables, book cases, and other architectural pieces. Facility has an overhead heater at about 18 feet above the finished floor in the coating area.

Job Description: Demonstration - Stain - Sanding Sealer + Lacquer

Time of Day: 10:00 AM Start: 10:00AM Finish: 11:45AM

Temperature: 72°F Humidity: 50% Dew Point:

Weather: ☐ Clear ☐ Cloudy ☒ Overcast ☐ Rain

Surface Description: ☒ Interior ☐ Exterior ☐ New ☐ Previously Painted

Area, Square Feet: 2 – 3' X 3' oak laminate panels

Substrate Construction: ☐ Plaster ☐ Wallboard ☒ Wood ☐ Metal ☐ Stucco ☐ Other ☐ Textured

Surface Preparation: ☐ Primed ☒ Sanded ☐ Washed ☐ Other ☐ Sand-blasted

Sanded with 120-grit paper and blew off dust.

Paint Application Method

Application Data

☐ Brush Type: _____ ☐ Roller Type: _____

☒ Spray Equipment ☐ Airless ☐ HVLP ☒ Conventional

Tip Size, Filter Size: Number 66

Was Product Thinned?: ☐ Yes How much _____

☒ No

Wet Film Thickness: Two wet coats, 5-6 mils thick, measured using a wet comb.

Describe Application Technique (e.g. cut-in, spray and back-rolled, etc.):

Spray – Excellent spray characteristics, no plugging, applied evenly for topcoat and sanding sealer

Product Evaluation

Spray: Does the paint work well, easily controlled? ☒ Yes ☐ No

Does the tip clog? ☐ Yes ☒ No

Performance Data for Sanding Sealer

Rate product performance using provided scale

	Excellent	Very Good	Good	Fair	Poor
☐ Dry Time – Dry to Touch	1- ☒	2- ☐	3- ☐	4- ☐	5- ☐
☐ Dry Time – Recoat Time	1- ☒	2- ☐	3- ☐	4- ☐	5- ☐
☐ Flow and Leveling	1- ☒	2- ☐	3- ☐	4- ☐	5- ☐
☐ Sanding Properties	1- ☐	2- ☐	3- ☒	4- ☐	5- ☐

Comments: Sanding sealer dried in 7 minutes, sanded with 280-grit sandpaper. Sands very easily - About the same as solvent sanding sealer.

Performance Data for Lacquer 1st Coat

Rate product performance using provided scale

		Excellent	Very Good	Good	Fair	Poor
☐	Dry Time – Dry to Touch	1- ☒	2- ☐	3- ☐	4- ☐	5- ☐
☐	Dry Time – Recoat Time	1- ☒	2- ☐	3- ☐	4- ☐	5- ☐
☐	Flow and Leveling	1- ☐	2- ☐	3- ☒	4- ☐	5- ☐
☐	Touch Up Ability	1- ☒	2- ☐	3- ☐	4- ☐	5- ☐

Comments: 1st Coat – 10:30AM – Dried at 10:42AM – Orange peel

Performance Data for Lacquer 2nd Coat

Rate product performance using provided scale

		Excellent	Very Good	Good	Fair	Poor
☐	Dry Time – Dry to Touch	1- ☒	2- ☐	3- ☐	4- ☐	5- ☐
☐	Dry Time – Recoat Time	1- ☒	2- ☐	3- ☐	4- ☐	5- ☐
☐	Flow and Leveling	1- ☐	2- ☒	3- ☐	4- ☐	5- ☐
☐	Touch Up Ability	1- ☒	2- ☐	3- ☐	4- ☐	5- ☐

Comments: 2nd Coat – 10:47AM – Dried at 11:00AM – Orange peel

Performance Data for Lacquer 3rd Coat – ½ Panel

Rate product performance using provided scale

		Excellent	Very Good	Good	Fair	Poor
☐	Dry Time – Dry to Touch	1- ☒	2- ☐	3- ☐	4- ☐	5- ☐
☐	Dry Time – Recoat Time	1- ☒	2- ☐	3- ☐	4- ☐	5- ☐
☐	Flow and Leveling	1- ☐	2- ☒	3- ☐	4- ☐	5- ☐
☐	Touch Up Ability	1- ☐	2- ☒	3- ☐	4- ☐	5- ☐

Comments: 3rd Coat – 12 Minutes dry time – Flow and leveling properties improved - Depth improved.

Performance Data for Lacquer 4th Coat – ½ Panel

Rate product performance using provided scale

		Excellent	Very Good	Good	Fair	Poor
☐	Dry Time – Dry to Touch	1- ☒	2- ☐	3- ☐	4- ☐	5- ☐
☐	Dry Time – Recoat Time	1- ☒	2- ☐	3- ☐	4- ☐	5- ☐
☐	Flow and Leveling	1- ☐	2- ☒	3- ☐	4- ☐	5- ☐
☐	Touch Up Ability	1- ☒	2- ☐	3- ☐	4- ☐	5- ☐

Comments: 4th Coat – 12 Minutes dry time – 85° Gloss.

Uniformity (compare the firm's uniformity, with respect to (primer/flat) hat banding, flashing, touch-up (eggshell/semi gloss) enamel holdout, gloss, sheen.)

Lacquer – As good, or better than any other water based lacquer.

Film Defects (note any mud cracking, cratering, crawling, flashing, pin holing, orange peel, sagging, etc.)

Lacquer – 2nd coat a little orange peel, 3rd coat none.

Overall Product Evaluation

What did you like about this product?

Sanding Sealer – Powdered well, very good, dries fast.

Lacquer – Dries fast.

What don't you like about this product?

Sanding Sealer – Nothing, everything OK.

Lacquer – Flow not as good as solvent, orange peel.

If you could change anything about this product, what would it be?

Sanding Sealer – Nothing.

Lacquer – Better flow, and leveling.

Does this product meet your expectation for these types of uses?

Sanding Sealer – Yes.

Lacquer – Not milky, looks good.

South Coast Air Quality Management District Field Demonstration

Product Performance Form

12/13/00

Present: Rich Hosman, Jeff Wong, Guillermo Garcia

Name: Commercial Casework

System Description (Resin type, etc.): Sanding Sealer, Acrylic Varnish, Epoxy

Background (To do this job, what type (brand) of product would you typically use?: AMT Sealer, AMT "A" Series Stain - All individually 450 g/L VOC, solvent-based with exempt solvents.

Facility Description: At a woodworking and coating facility. Typical output includes: conference tables, book cases, and other architectural pieces. Facility has an overhead heater at about 18 feet above the finished floor in the coating area.

Job Description: Demonstration : Stain + Sanding Sealer + Varnish

Time of Day: 10:00 AM Start: 10:00AM Finish: 11:45AM

Temperature: 72°F Humidity: 50% Dew Point:

Weather: ☐ Clear ☐ Cloudy ☒ Overcast ☐ Rain

Spraying Environment: ☒ Interior ☐ Exterior ☐ New ☐ Previously Painted

Area, Square Feet: 2 – 3' X 3' oak laminate panels

Substrate Construction: ☐ Plaster ☐ Wallboard ☒ Wood ☐ Metal ☐ Stucco ☐ Other ☐ Textured

Surface Preparation: ☐ Primed ☒ Sanded ☐ Washed ☐ Other ☐ Sand-blasted

Sanded with 120-grit paper and blew off dust.

Paint Application Method

Application Data

☐ Brush Type: _____ ☐ Roller Type: _____

☒ Spray Equipment ☐ Airless ☐ HVLP ☒ Conventional

Tip Size, Filter Size: Number 66

Was Product Thinned?: ☐ Yes How much _____

☒ No

Wet Film Thickness: Two wet coats, 5-6 mils thick, measured with a wet comb.

Describe Application Technique (e.g. cut-in, spray and back-rolled, etc.):

Spray – Excellent spray characteristics, no plugging, applied evenly for all coats.

Product Evaluation

Spray: Does the paint work well, easily controlled? ☒ Yes ☐ No

Does the tip clog? ☐ Yes ☒ No

Performance Data for Sanding Sealer

Rate product performance using provided scale

	Excellent	Very Good	Good	Fair	Poor
☐ Dry Time – Dry to Touch	1- ☒	2- ☐	3- ☐	4- ☐	5- ☐
☐ Dry Time – Recoat Time	1- ☒	2- ☐	3- ☐	4- ☐	5- ☐
☐ Flow and Leveling	1- ☒	2- ☐	3- ☐	4- ☐	5- ☐
☐ Sanding Properties	1- ☐	2- ☐	3- ☒	4- ☐	5- ☐

Comments: Sanding sealer dried in 7 minutes, sanded with 280-grit sandpaper. Sands very easily - About the same as solvent sanding sealer.

Performance Data for Varnish 1st Coat

Rate product performance using provided scale

		Excellent	Very Good	Good	Fair	Poor
☐	Dry Time – Dry to Touch	1- ☒	2- ☐	3- ☐	4- ☐	5- ☐
☐	Dry Time – Recoat Time	1- ☒	2- ☐	3- ☐	4- ☐	5- ☐
☐	Flow and Leveling	1- ☒	2- ☐	3- ☐	4- ☐	5- ☐
☐	Touch Up Ability	1- ☒	2- ☐	3- ☐	4- ☐	5- ☐

Comments: 1st Coat – 10:34AM – Dried at 11:05AM – Initial milky appearance.

Performance Data for Varnish 2nd Coat

Rate product performance using provided scale

		Excellent	Very Good	Good	Fair	Poor
☐	Dry Time – Dry to Touch	1- ☒	2- ☐	3- ☐	4- ☐	5- ☐
☐	Dry Time – Recoat Time	1- ☒	2- ☐	3- ☐	4- ☐	5- ☐
☐	Flow and Leveling	1- ☒	2- ☐	3- ☐	4- ☐	5- ☐
☐	Touch Up Ability	1- ☒	2- ☐	3- ☐	4- ☐	5- ☐

Comments: 2nd – 11:06AM – Dried at 11:21AM – Initially milky appearance – After drying Appeared good – But still a little milky - Yellowness

Uniformity (compare the firm's uniformity, with respect to (primer/flat) hat banding, flashing, touch-up (eggshell/semi gloss) enamel holdout, gloss, sheen.)

Varnish 1st Coat

Film Defects (note any mud cracking, cratering, crawling, flashing, pin holing, orange peel, sagging, etc.)

Varnish 2nd – Little milky and yellow.

Overall Product Evaluation

What did you like about this product?

Sanding Sealer – Powdered well, very good, dries fast.

Varnish – Durable, looks good, slightly milky.

What don't you like about this product?

Sanding Sealer – Nothing, everything OK.

Varnish – Don't know durability, milky, and slightly yellow .

If you could change anything about this product, what would it be?

Sanding Sealer – Nothing.

Varnish – Better flow, get rid of milky appearance.

Does this product meet your expectation for these types of uses?

Sanding Sealer – Yes.

Varnish – Little milky

Appendix E

Coating Product Data Sheet

ADCO

Product Information Sheet

Product: Lacquer WLC-6C

Purpose: High quality, high clarity, single component wood topcoat. This topcoat has Zero VOCs and very low odor. This a waterbased product with a extemely low flammability. It has good resistance to household chemicals and gives a mar resistant, abrasion resistant gloss finish.

Weight per gallon: 8.60

Nonvolatile: 30%

Dry Times: Dry to handle in 1 hour. Dry to recoat in 2 hours.

Surface preparation: On bare wood, the wood shall be clean, dry, and free of all contaminants. Sand smooth to a uniform surface with 120 grit sandpaper or better. Do not use steel wool. Remove all dust.
On stains: be sure the stain is fully cured. The surface should be clean and dry.
Over sanding sealers or 2nd coat of a self-sealing system: Sand lightly with 220 grit or finer sandpaper and remove dust.

Application: Stir thoroughly- do not shake. The lacquer may be applied by conventional air gun, HVLP gun or airless spray (0.017 or 0.015 tip), or good quality nylon- polyester brush. Apply at three mils wet per coat. A minimum of three coats on a self-sealing system over bare wood or two coats over a sealer or a stain are needed for appearance and durability. The lacquer may be recoated 2 hours after application under standard drying conditions of 70°F and 50% relative humidity. If several days have passed between coats, a light sanding with 220 grit sandpaper will insure the adhesion of subsequent coats.
The finish maybe touched up by a light sanding with 220 grit or finer sandpaper after the topcoat has dried overnight.
If you have a extreme grain raise situation, apply two coats of the lacquer and let fully dry overnight and sand with 220 grit sandpaper. Remove the dust and apply two more coats of lacquer.

Coverage: 350 –400 sq. ft/ gal
Thinning is not recommended
Clean up with soap and water
Gloss potential 75-80 @ 60° over wood.
Protect from Freezing

MATERIAL SAFETY DATA SHEET

PRODUCT: Adhesive Coatings Lacquer WLC-6C

PART 1 - GENERAL INFORMATION

Manufacturer:
Adhesive Coatings
2471 Peralta Street
Oakland, CA 94607
(510) 451-2470

NPCA HMIS Rating

Health:	1
Flammability:	0
Reactivity:	0
Personal Protection:	D

Emergency Numbers: 1-800-424-9300 (Chemtrec)

Chemical Family:	Latex Paint
Generic Name:	Water Based Paint
DOT Proper Shipping Name:	Water Based Paint, n.o.s.
DOT Hazard Class:	Not Regulated

Revision: 3 Date: 3/16/01

PART 2 - Ingredients

Ingredient Name	CAS #	%weight	OSHA(pel)	ACGIH(tlv)
Acrylic Co-polymer	25987-66-0	10-50	n/a	n/a

PART 3 - PHYSICAL AND CHEMICAL DATA

VOC of Material: 0 grams/liter and 0 #/gal
VOC excluding water: 0 grams/liter and 0 #/gal
Volatile portion: 55-85 % wt
Specific Gravity: 1.0-1.3 @20°C
Solubility in water: Dilutable
Boiling Point: 100°C
pH: 7.5 - 9
Freezing Point: 0°C
Viscosity: 50-75 KU
Vapor Pressure: Negligible
Appearance and Odor: Thick White Liquid / mild odor
Conditions and materials to avoid: High temperatures, oxidizing conditions.
Hazardous decomposition products: Acrid smoke, fumes, carbon monoxide/dioxide may be released upon decomposition.

PART 4 - FIRE AND EXPLOSION

Flash Point: > 250°C (Method: ISO 3679)
Autoignition temperature: N/DA
Flammable limits (%volume in air) Lower: N/DA Upper: N/DA
Fire and explosion hazards: Not-flammable
Extinguishing media: Dry chemical, CO_2, Water spray, Foam, Water fog.
Special fire-fighting procedures: Do not enter fire area without special protection. Fight fire from safe distance or protected location. Heat or impurities may increase temperature, build pressure, rupture closed containers spreading fire and increase the risk of burns and injuries. Use water spray/fog for cooling. Notify authorities if liquid enters sewer or public waters.

PART 5 - EMERGENCY AND FIRST AID

Inhalation: If overcome by exposure, remove victim to fresh air immediately. Give oxygen or artificial respiration as needed. Obtain emergency medical attention, prompt action is essential.
Eye Contact: In case of eye contact, immediately flush eyes with clean water for 20 - 30 minutes. Retract eyelids often. Obtain emergency medical attention if pain, blinking, tears, or redness persist.
Skin Contact: Remove contaminated clothing as needed. Wash skin thoroughly with mild soap and water. Flush with lukewarm water for 15 minutes. If sticky, use waterless hand cleaner first.
Ingestion: If large quantity is swallowed, give lukewarm water (1 pint) if victim is completely conscious and alert. Do not induce vomiting, risk of damage to lungs exceeds poisoning risk. Obtain emergency medical attention.
Emergency Medical Treatment: Treat symptomatically.

PART 6 - EFFECTS OF EXPOSURE

Routes of exposure:
Inhalation: This material is not expected to present an inhalation hazard at standard conditions due to its low volatility. However, overexposure to mists/aerosols may cause respiratory tract irritation such as coughing, shortness of breath, and mucus production.
Eye Contact: Potential route. May cause eye irritation. Symptoms may include tearing, blinking, redness and swelling.
Skin absorption: Potential route. Although no data was found for this product, the potential for skin absorption does exist.
Skin Irritation: Potential route. May produce skin irritation. May cause an allergic skin reaction in some individuals after repeated skin contact.
Ingestion: This material may be a health hazard if ingested in large quantities.
Medical conditions aggravated by exposure: No additional medical information found.

PART 7 - PROTECTIVE EQUIPMENT AND CONTROL MEASURES

Respiratory Protection: If this material is handled under mist forming conditions, use NIOSH/MSHA approved respiratory protection equipment.
Eye Protection: Eye protection such as chemical splash goggles and/or face shield must be worn when possibility exists for eye contact due to splashing or spraying, liquid, airborne particles, or vapor. Contact lenses should not be worn.
Skin Protection: Depending on the conditions for use, protective gloves, apron, boots, head, and face protection should be worn. This equipment should be cleaned after each use.
Engineering Controls: If handling results in mist or aerosol or vapor generation, local exhaust ventilation is recommended.
Other Hygienic Practices: Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure.
Other Work Practices: Use good personal hygiene. Wash hands before eating, drinking, smoking, or using the toilet facilities. Promptly remove soiled clothing and wash thoroughly before reuse. Shower after work using plenty of soap and water.

PART 8 - REACTIVITY DATA

Stability: Stable
Incompatibility: Strong bases and acids.
Hazardous polymerization: Will not occur.
Hazardous decomposition: Will not occur.

PART 9 - SPILL OR LEAK PROCEDURES

Avoid all personal contact. Take up with absorbent material. Scoop and vacuum up, place in closed container for disposal. Avoid dusting. Flush contaminated area with water. Dispose in accordance with federal, state, and local regulations.

PART 10 - STORAGE AND SPECIAL PRECAUTIONS

SPECIAL PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE:
Practice caution and personal cleanliness to avoid skin and eye contact. Avoid breathing vapors of heated material.

PART 11 - REGULATORY INFORMATION

TRANSPORTATION
Not Regulated

PART 12 - LABEL INFORMATION

FOR INDUSTRIAL USE ONLY!! Skin contact hazard. Eye and skin irritant.
May cause allergic reaction. Avoid contact with eyes, skin, and clothing. Do not breath vapors or mist. Wash thoroughly after handling. Do not swallow. Prevent contact with food, chewing or smoking materials.

FIRST AID

EYES: Immediately flush with plenty of clean water
INHALATION: Remove to fresh air if effects occur. Consult a physician.
SKIN CONTACT: Wash thoroughly with mild soap and flowing water or shower.
INGESTION: Give fluids. Call a physician.
NOTE TO PHYSICIAN: No specific antidote. Supportive care. Treatment based on judgment of physician in response to reaction of the patient.

ADCO

Product Information Sheet

Product: Gloss Wood Varnish Catalyzed WTC-99

This clear gloss is a high performance epoxy coating suitable for application on furniture, cabinets, flat stock, molding, paneling and other wood applications. This two- component water-based product is a hard, durable, chemical and stain resistant interior wood coating that contains no organic solvents. It is designed to be applied directly over wood stains, sealers or bare wood. Because it cures by a chemical reaction, it has success over oily woods and over woods with high natural acids. It can be applied easily by conventional spray systems or brush

Color: Clear
Finish: Gloss
Pot Life: 4 hours
Clean Up: Warm, soapy water
Density: 9.0#/gal (Mixed system)
Volume Solids: 30%
Weight Solids: 35%
Shelf Life: > 1 year
Flash Point: > 350 °F
Dry Time: @ 77°F/50%R.H., 3 mil wet film
To touch: 30 minutes
To recoat: 1 hour
To handle: approx. 2-4 hours
Viscosity: approx. 75 KUs
Usage (by volume): Part A 2 Part B 1
Induction Time: None
Intercoat Adhesion: Excellent
Thinner: Water

Pencil Hardness: 2H
Abrasion Resistance: excellent
Mar Resistance: excellent
Chemical Resistance:
Water
Cleaners and Detergents
Foods and Beverages
Mild Acids and Bases
Alcohols

Theoretical Coverage:
1 mil (dry) / 2 mil (wet): 475 square feet
2 mil (dry) / 4 mil (wet): 238 sq. ft.
3 mil (dry) / 6 mil (wet): 158 sq. ft.

Hot /Cold Check passes 6 cycles

Surface preparation: On bare wood, the wood shall be clean, dry, and free of all contaminants. Sand smooth to a uniform surface with 120-grit sandpaper or better. Do not use steel wool. Remove all dust.
On stains: be sure the stain is fully cured. The surface should be clean and dry.
Over sanding sealers or 2nd coat of a self-sealing system: Sand lightly with 220 grit Or finer sandpaper and remove dust.
Application: Stir thoroughly- does not shake.
The mix ratio is 2 parts of B to one part of A. While stirring part A, slowly add part B, and continue mixing for 3-4 minutes.
The useable life of this varnish is 4 hours from the time of mixing. You cannot re-catalyze the unapplied coating.

ADCO

Application continued-

The varnish may be applied by conventional air gun, HVLP gun or airless spray (0.017 or 0.015 tip), or good quality nylon- polyester brush. Apply at three mils wet per coat. A minimum of three coats on a self-sealing system over bare wood or two coats over a sealer or a stain are needed for appearance and durability. The varnish may be recoated 2 hours after application under standard drying conditions of 70°F and 50% relative humidity.
The cured finish maybe touched up with fresh varnish by a light sanding with 220 grit or finer sandpaper and reapplying.
If you have an extreme grain raise situation, apply two coats of the varnish and let fully dry overnight and sand with 220 grit sandpaper. Remove the dust and apply one more coat of varnish.

Coverage: 350 –400 sq. ft/ gal

Thinning is not recommended

Clean up with soap and water while varnish is wet. The cured product is very difficult to remove from brushes or guns.

Gloss potential 70-80 @ 60° over wood.

Protect form Freezing

MATERIAL SAFETY DATA SHEET

PRODUCT: Adhesive Coatings Catalyzed varnish WTC-99 Part A

PART 1 - GENERAL INFORMATION

Manufacturer:
Adhesive Coatings
2471 PERALTA Street
Oakland, CA 94607
(510) 451-2326

NPCA HMIS Rating

Flammability:	0
Health:	1
Reactivity:	0
Personal Protection:	D

Emergency Numbers: 1-800-424-9300 (Chemtrec)

Chemical Family:	Latex Paint
Generic Name:	Water Based Epoxy Paint
DOT Proper Shipping Name:	Water Based Paint, n.o.s.
DOT Hazard Class:	Not Regulated

Revision: 7 Date: 2/13/01

PART 2 - Ingredients

Ingredient Name	CAS #	%weight	OSHA(pel)	ACGIH(tlv)
Epoxy Polymer	025085-99-8	35-60%	N/A	N/A

PART 3 - PHYSICAL AND CHEMICAL DATA

VOC of Material: 0 grams/liter and 0 #/gal
VOC excluding water: 0 grams/liter and 0 #/gal
Volatile portion: 45-50 % wt
Specific Gravity: 1.09 @20°C
Solubility in water: Dilutable
Boiling Point: 100°C
pH: 6.0 – 8.0
Freezing Point: 0°C
Viscosity: 700-1500 cps
Vapor Pressure: Negligible
Appearance and Odor: Milky White Liquid / mild odor
Conditions and materials to avoid: High temperatures, oxidizing conditions.
Hazardous decomposition products: Acrid smoke, fumes, carbon monoxide/dioxide may be released upon decomposition.

PART 4 - FIRE AND EXPLOSION

Flash Point: > 250°C (Method: ISO 3679)
Autoignition temperature: N/A
Flammable limits (%volume in air) Lower: N/A Upper: N/A
Fire and explosion hazards: Not-flammable
Extinguishing media: Dry chemical, CO_2, Water spray, Foam, Water fog.
Special fire-fighting procedures: Do not enter fire area without special protection. Fight fire from safe distance or protected location. Heat or impurities may increase temperature, build pressure, rupture closed containers spreading fire and increase the risk of burns and injuries. Use water spray/fog for cooling. Notify authorities if liquid enters sewer or public waters.

PART 5 - EMERGENCY AND FIRST AID

Inhalation: If overcome by exposure, remove victim to fresh air immediately. Give oxygen or artificial respiration as needed. Obtain emergency medical attention, prompt action is essential.
Eye Contact: In case of eye contact, immediately flush eyes with clean water for 20 - 30 minutes. Retract eyelids often. Obtain emergency medical attention if pain, blinking, tears, or redness persist.
Skin Contact: Remove contaminated clothing as needed. Wash skin thoroughly with mild soap and water. Flush with lukewarm water for 15 minutes. If sticky, use waterless hand cleaner first.
Ingestion: If large quantity is swallowed, give lukewarm water (1 pint) if victim is completely conscious and alert. Do not induce vomiting, risk of damage to lungs exceeds poisoning risk. Obtain emergency medical attention.
Emergency Medical Treatment: Treat symptomatically.

PART 6 - EFFECTS OF EXPOSURE

Routes of exposure:
Inhalation: This material is not expected to present an inhalation hazard at standard conditions due to its low volatility. However, overexposure to mists/aerosols may cause respiratory tract irritation such as coughing, shortness of breath, and mucus production.
Eye Contact: Potential route. May cause eye irritation. Symptoms may include tearing, blinking, redness and swelling.
Skin absorption: Potential route. Although no data was found for this product, the potential for skin absorption does exist.
Skin Irritation: Potential route. May produce skin irritation. May cause an allergic skin reaction in some individuals after repeated skin contact.
Ingestion: This material may be a health hazard if ingested in large quantities.
Medical conditions aggravated by exposure: No additional medical information found.

PART 7 - PROTECTIVE EQUIPMENT AND CONTROL MEASURES

Respiratory Protection: If this material is handled under mist forming conditions, use NIOSH/MSHA approved respiratory protection equipment.
Eye Protection: Eye protection such as chemical splash goggles and/or face shield must be worn when possibility exists for eye contact due to splashing or spraying, liquid, airborne particles, or vapor. Contact lenses should not be worn.
Skin Protection: Depending on the conditions for use, protective gloves, apron, boots, head, and face protection should be worn. This equipment should be cleaned after each use.
Engineering Controls: If handling results in mist or aerosol or vapor generation, local exhaust ventilation is recommended.
Other Hygienic Practices: Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure.
Other Work Practices: Use good personal hygiene. Wash hands before eating, drinking, smoking, or using the toilet facilities. Promptly remove soiled clothing and wash thoroughly before reuse. Shower after work using plenty of soap and water.

PART 8 - REACTIVITY DATA

Stability: Stable
Incompatibility: Strong bases and acids.
Hazardous polymerization: Will not occur.
Hazardous decomposition: Will not occur.

PART 9 - SPILL OR LEAK PROCEDURES

Avoid all personal contact. Take up with absorbent material. Scoop and vacuum up, place in closed container for disposal. Avoid dusting. Flush contaminated area with water. Dispose in accordance with federal, state, and local regulations.

PART 10 - STORAGE AND SPECIAL PRECAUTIONS

SPECIAL PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE:
Practice caution and personal cleanliness to avoid skin and eye contact. Avoid breathing vapors of heated material.

PART 11 - REGULATORY INFORMATION

TRANSPORTATION
Not Regulated

PART 12 - LABEL INFORMATION

FOR INDUSTRIAL USE ONLY!! Skin contact hazard. Eye and skin irritant.
May cause allergic reaction. Avoid contact with eyes, skin, and clothing. Do not breath vapors or mist. Wash thoroughly after handling. Do not swallow. Prevent contact with food, chewing or smoking materials.

FIRST AID

EYES: Immediately flush with plenty of clean water
INHALATION: Remove to fresh air if effects occur. Consult a physician.
SKIN CONTACT: Wash thoroughly with mild soap and flowing water or shower.
INGESTION: Give fluids. Call a physician.
NOTE TO PHYSICIAN: No specific antidote. Supportive care. Treatment based on judgment of physician in response to reaction of the patient.

N/A= not available

MATERIAL SAFETY DATA SHEET

PRODUCT: Adhesive Coatings - Catalyzed varnish WTC-99 Part B

PART 1 - GENERAL INFORMATION

Manufacturer:
Adhesive Coatings
2471 Peralta Street
Oakland, CA 94607
(510) 451-23326

NPCA HMIS Rating

Health:	2
Flammability:	0
Reactivity:	0
Personal Protection:	D

Emergency Numbers: 1-800-424-9300 (Chemtrec)

Chemical Family:	Mixture
Generic Name:	Epoxy Curing Agent,
DOT Proper Shipping Name:	Not Regulated
DOT Hazard Class:	Not Regulated

Revision: 6 Date: 2/13/01

PART 2 - Ingredients

Ingredient Name	CAS #	%weight	OSHA(pel)	ACGIH(tlv)
Tetraethylenepentamine (polyamine)	112-57-2	<1%	N/A	N/A

PART 3 - PHYSICAL AND CHEMICAL DATA

VOC of Material: 0 grams/liter and 0 #/gal
VOC excluding water: 0 grams/liter and 0 #/gal
Volatile portion: 60-85% wt
Specific Gravity: 1.05-1.5 @20°C
Solubility in water: Dilutable
Boiling Point: 100°C
pH: 10.0-11.0
Freezing Point: 0°C
Viscosity: 50-350 cps
Vapor Pressure: Negligible
Appearance and Odor: Thin translucent liquid / slight odor
Conditions and materials to avoid: High temperatures, oxidizing conditions.
Hazardous decomposition products: Acrid smoke, fumes, carbon monoxide/dioxide may be released upon decomposition.

PART 4 - FIRE AND EXPLOSION

Flash Point: > 250°C (Method: ISO 3679)
Auto-ignition temperature: N/DA
Flammable limits (%volume in air) Lower: N/DA Upper: N/DA
Fire and explosion hazards: Not-flammable
Extinguishing media: Dry chemical, CO_2, Water spray, Foam, Water fog.
Special fire-fighting procedures: Do not enter fire area without special protection. Fight fire from safe distance or protected location. Heat or impurities may increase temperature, build pressure, rupture closed containers spreading fire and increase the risk of burns and injuries. Use water spray/fog for cooling. Notify authorities if liquid enters sewer or public waters.

PART 5 - EMERGENCY AND FIRST AID

Inhalation: If overcome by exposure, remove victim to fresh air immediately. Give oxygen or artificial respiration as needed. Obtain emergency medical attention, prompt action is essential.
Eye Contact: In case of eye contact, immediately flush eyes with clean water for 20 - 30 minutes. Retract eyelids often. Obtain emergency medical attention if pain, blinking, tears, or redness persist.
Skin Contact: Remove contaminated clothing as needed. Wash skin thoroughly with mild soap and water. Flush with lukewarm water for 15 minutes. If sticky, use waterless hand cleaner first.
Ingestion: If large quantity is swallowed, give lukewarm water (1 pint) if victim is completely conscious and alert. Do not induce vomiting, risk of damage to lungs exceeds poisoning risk. Obtain emergency medical attention.
Emergency Medical Treatment: Treat symptomatically.

PART 6 - EFFECTS OF EXPOSURE

Routes of exposure:
Inhalation: This material is not expected to present an inhalation hazard at standard conditions due to its low volatility. However, overexposure to mists/aerosols may cause respiratory tract irritation such as coughing, shortness of breath, and mucus production.
Eye Contact: Potential route. May cause eye irritation. Symptoms may include tearing, blinking, redness and swelling.
Skin absorption: Potential route. Although no data was found for this product, the potential for skin absorption does exist.
Skin Irritation: Potential route. May produce skin irritation. May cause an allergic skin reaction in some individuals after repeated skin contact.
Ingestion: This material may be a health hazard if ingested in large quantities.
Medical conditions aggravated by exposure: No additional medical information found.

PART 7 - PROTECTIVE EQUIPMENT AND CONTROL MEASURES

Respiratory Protection: If this material is handled under mist forming conditions, use NIOSH/MSHA approved respiratory protection equipment.
Eye Protection: Eye protection such as chemical splash goggles and/or face shield must be worn when possibility exists for eye contact due to splashing or spraying, liquid, airborne particles, or vapor. Contact lenses should not be worn.
Skin Protection: Depending on the conditions for use, protective gloves, apron, boots, head, and face protection should be worn. This equipment should be cleaned after each use.
Engineering Controls: If handling results in mist or aerosol or vapor generation, local exhaust ventilation is recommended.
Other Hygienic Practices: Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure.
Other Work Practices: Use good personal hygiene. Wash hands before eating, drinking, smoking, or using the toilet facilities. Promptly remove soiled clothing and wash thoroughly before reuse. Shower after work using plenty of soap and water.

PART 8 - REACTIVITY DATA

Stability: Stable
Incompatibility: Strong acids.
Hazardous polymerization: Will not occur.
Hazardous decomposition: Will not occur.

PART 9 - SPILL OR LEAK PROCEDURES

Avoid all personal contact. Take up with absorbent material. Scoop and vacuum up, place in closed container for disposal. Avoid dusting. Flush contaminated area with water. Dispose in accordance with federal, state, and local regulations.

PART 10 - STORAGE AND SPECIAL PRECAUTIONS

SPECIAL PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE:
Practice caution and personal cleanliness to avoid skin and eye contact. Avoid breathing vapors of heated material.

PART 11 - REGULATORY INFORMATION

TRANSPORTATION:
DOT Hazard Class: Not Regulated
Proper shipping name: Not Regulated
EPA: N/A California Proposition 65: N/A

PART 12 - LABEL INFORMATION

FOR INDUSTRIAL USE ONLY!! Skin contact hazard. Eye and skin irritant.
May cause allergic reaction. Avoid contact with eyes, skin, and clothing. Do not breath vapors or mist. Wash thoroughly after handling. Do not swallow. Prevent contact with food, chewing or smoking materials.

FIRST AID

EYES: Immediately flush with plenty of clean water
INHALATION: Remove to fresh air if effects occur. Consult a physician.
SKIN CONTACT: Wash thoroughly with mild soap and flowing water or shower.
INGESTION: Give fluids. Call a physician.
NOTE TO PHYSICIAN: No specific antidote. Supportive care. Treatment based on judgment of physician in response to reaction of the patient.
N/A= not available

ADCO

Product Information Sheet

Product: Exterior Opaque Stain Redwood

Purpose: Beautify and protect exterior wood surfaces with a Zero VOC product
Fade resistant, all acrylic high quality, high hiding exterior finish

Weight per gallon: 10.05 pounds per gallon

Nonvolatile : 43 - 44% by weight

Dry Times: 1- 2 hours dry hard, recoat 2 hours

Surface preparation: New wood- Loose wood fibers shall be removed with a stiff bristle brush. All surfaces must be clean and free of all dust, mildew, oil, soot, and other contaminants. Smooth wood and mill glazed wood should be scuff sanded.
Previously painted wood- All surfaces must be clean and free of all dust, mildew, oil, soot, and other contaminants. Wash all surfaces completely with a detergent solution and rinsed thoroughly with clean water. Allow to dry before painting.
If mildew is present, the surface should be treated with a solution of 4 parts water and 1 part household bleach. This should dry on the surface and then the surface should be rinsed with clean water and let dry before painting.
Application – Stir thoroughly. Use a synthetic bristle brush, roller with at least ½" nap, or airless spray using a tip size of 0.017" to 0.021". On rough woods, the coating should be back brushed while wet to force the coating into all the texture of the wood.
One coat should be sufficient on previously painted surfaces, two coats on new and/or rough sawn woods. Coverage - On rough woods – 150 to 250 square feet , on smooth wood 250 to 400 square feet. Cleanup with soap and water

Precautions:
Do not apply below 50° F, when rain is expected or late in the day when dew will form.
Do not apply in direct sunlight.
Do not allow to freeze
No thinning recommended.

MATERIAL SAFETY DATA SHEET

PRODUCT: Adhesive Coatings Exterior Opaque Stain Redwood

PART 1 - GENERAL INFORMATION

Manufacturer:
Adhesive Coatings
2471 Peralta Street
Oakland, CA 94607
(510) 451-2470

NPCA HMIS Rating

Health:	1
Flammability:	0
Reactivity:	0
Personal Protection:	D

Emergency Numbers: 1-800-424-9300 (Chemtrec)

Chemical Family:	Latex Paint
Generic Name:	Water Based Paint
DOT Proper Shipping Name:	Water Based Paint, n.o.s.
DOT Hazard Class:	Not Regulated

Revision: 3 Date: 3/16/01

PART 2 - Ingredients

Ingredient Name	CAS #	%weight	OSHA(pel)	ACGIH(tlv)
Acrylic Co-polymer	25987-66-0	20-40	n/a	n/a
Zinc Borate	12513-27-8	0.5-5%	n/a	n/a

PART 3 - PHYSICAL AND CHEMICAL DATA

VOC of Material: 0 grams/liter and 0 #/gal
VOC excluding water: 0 grams/liter and 0 #/gal
Volatile portion: 45-75 % wt
Specific Gravity: 1.0-1.3 @20°C
Solubility in water: Dilutable
Boiling Point: 100°C
pH: 7.5 - 9
Freezing Point: 0°C
Viscosity: 60-85 KU
Vapor Pressure: Negligible
Appearance and Odor: Thick White Liquid / mild odor
Conditions and materials to avoid: High temperatures, oxidizing conditions.
Hazardous decomposition products: Acrid smoke, fumes, carbon monoxide/dioxide may be released upon decomposition.

PART 4 - FIRE AND EXPLOSION

Flash Point: > 250°C (Method: ISO 3679)
Autoignition temperature: N/DA
Flammable limits (%volume in air) Lower: N/DA Upper: N/DA
Fire and explosion hazards: Not-flammable
Extinguishing media: Dry chemical, CO_2, Water spray, Foam, Water fog.
Special fire-fighting procedures: Do not enter fire area without special protection. Fight fire from safe distance or protected location. Heat or impurities may increase temperature, build pressure, rupture closed containers spreading fire and increase the risk of burns and injuries. Use water spray/fog for cooling. Notify authorities if liquid enters sewer or public waters.

PART 5 - EMERGENCY AND FIRST AID

Inhalation: If overcome by exposure, remove victim to fresh air immediately. Give oxygen or artificial respiration as needed. Obtain emergency medical attention, prompt action is essential.
Eye Contact: In case of eye contact, immediately flush eyes with clean water for 20 - 30 minutes. Retract eyelids often. Obtain emergency medical attention if pain, blinking, tears, or redness persist.
Skin Contact: Remove contaminated clothing as needed. Wash skin thoroughly with mild soap and water. Flush with lukewarm water for 15 minutes. If sticky, use waterless hand cleaner first.
Ingestion: If large quantity is swallowed, give lukewarm water (1 pint) if victim is completely conscious and alert. Do not induce vomiting, risk of damage to lungs exceeds poisoning risk. Obtain emergency medical attention.
Emergency Medical Treatment: Treat symptomatically.

PART 6 - EFFECTS OF EXPOSURE

Routes of exposure:
Inhalation: This material is not expected to present an inhalation hazard at standard conditions due to its low volatility. However, overexposure to mists/aerosols may cause respiratory tract irritation such as coughing, shortness of breath, and mucus production.
Eye Contact: Potential route. May cause eye irritation. Symptoms may include tearing, blinking, redness and swelling.
Skin absorption: Potential route. Although no data was found for this product, the potential for skin absorption does exist.
Skin Irritation: Potential route. May produce skin irritation. May cause an allergic skin reaction in some individuals after repeated skin contact.
Ingestion: This material may be a health hazard if ingested in large quantities.
Medical conditions aggravated by exposure: No additional medical information found.

PART 7 - PROTECTIVE EQUIPMENT AND CONTROL MEASURES

Respiratory Protection: If this material is handled under mist forming conditions, use NIOSH/MSHA approved respiratory protection equipment.
Eye Protection: Eye protection such as chemical splash goggles and/or face shield must be worn when possibility exists for eye contact due to splashing or spraying, liquid, airborne particles, or vapor. Contact lenses should not be worn.
Skin Protection: Depending on the conditions for use, protective gloves, apron, boots, head, and face protection should be worn. This equipment should be cleaned after each use.
Engineering Controls: If handling results in mist or aerosol or vapor generation, local exhaust ventilation is recommended.
Other Hygienic Practices: Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure.
Other Work Practices: Use good personal hygiene. Wash hands before eating, drinking, smoking, or using the toilet facilities. Promptly remove soiled clothing and wash thoroughly before reuse. Shower after work using plenty of soap and water.

PART 8 - REACTIVITY DATA

Stability: Stable
Incompatibility: Strong bases and acids.
Hazardous polymerization: Will not occur.
Hazardous decomposition: Will not occur.

PART 9 - SPILL OR LEAK PROCEDURES

Avoid all personal contact. Take up with absorbent material. Scoop and vacuum up, place in closed container for disposal. Avoid dusting. Flush contaminated area with water. Dispose in accordance with federal, state, and local regulations.

PART 10 - STORAGE AND SPECIAL PRECAUTIONS

SPECIAL PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE:
Practice caution and personal cleanliness to avoid skin and eye contact. Avoid breathing vapors of heated material.

PART 11 - REGULATORY INFORMATION

TRANSPORTATION
Not Regulated

PART 12 - LABEL INFORMATION

FOR INDUSTRIAL USE ONLY!! Skin contact hazard. Eye and skin irritant.
May cause allergic reaction. Avoid contact with eyes, skin, and clothing. Do not breath vapors or mist. Wash thoroughly after handling. Do not swallow. Prevent contact with food, chewing or smoking materials.

FIRST AID

EYES: Immediately flush with plenty of clean water
INHALATION: Remove to fresh air if effects occur. Consult a physician.
SKIN CONTACT: Wash thoroughly with mild soap and flowing water or shower.
INGESTION: Give fluids. Call a physician.
NOTE TO PHYSICIAN: No specific antidote. Supportive care. Treatment based on judgment of physician in response to reaction of the patient.

ADCO

Product Information Sheet

Product: Exterior Semitransparent Stain Redwood

Purpose: Beautify and protect exterior wood surfaces with a Zero VOC product
Fade resistant, all acrylic high quality exterior finish

Weight per gallon: 8.90 pounds per gallon

Nonvolatile : 30 - 31% by weight

Dry Times: 1- 2 hours dry hard, recoat 2 hours

Surface preparation: New wood- Loose wood fibers shall be removed with a stiff bristle brush. All surfaces must be clean and free of all dust, mildew, oil, soot, and other contaminants. Smooth wood and mill glazed wood should be scuff sanded.
Previously painted wood- All surfaces must be clean and free of all dust, mildew, oil, soot, and other contaminants. Wash all surfaces completely with a detergent solution and rinsed thoroughly with clean water. Allow to dry before painting.
If mildew is present, the surface should be treated with a solution of 4 parts water and 1 part household bleach. This should dry on the surface and then the surface should be rinsed with clean water and let dry before painting.
Application – Stir thoroughly. Use a synthetic bristle brush, roller with at least ½" nap, or airless spray using a tip size of 0.017" to 0.021". On rough woods, the coating should be back brushed while wet to force the coating into all the texture of the wood.
One coat should be sufficient on previously painted surfaces, two coats on new and/or rough sawn woods. Coverage - On rough woods – 150 to 250 square feet , on smooth wood 250 to 400 square feet. Cleanup with soap and water

Precautions:
Do not apply below 50° F, when rain is expected or late in the day when dew will form.
Do not apply in direct sunlight.
Do not allow to freeze
No thinning recommended.

MATERIAL SAFETY DATA SHEET

PRODUCT: Adhesive Coatings Exterior Semitransparent Stain Redwood

PART 1 - GENERAL INFORMATION

Manufacturer:
Adhesive Coatings
2471 Peralta Street
Oakland, CA 94607
(510) 451-2470

NPCA HMIS Rating

Health:	1
Flammability:	0
Reactivity:	0
Personal Protection:	D

Emergency Numbers: 1-800-424-9300 (Chemtrec)

Chemical Family:	Latex Paint
Generic Name:	Water Based Paint
DOT Proper Shipping Name:	Water Based Paint, n.o.s.
DOT Hazard Class:	Not Regulated

Revision: 3 Date: 3/16/01

PART 2 - Ingredients

Ingredient Name	CAS #	%weight	OSHA(pel)	ACGIH(tlv)
Acrylic Co-polymer	25987-66-0	20-40	n/a	n/a
Zinc Borate	12513-27-8	0.5-5%	n/a	n/a

PART 3 - PHYSICAL AND CHEMICAL DATA

VOC of Material: 0 grams/liter and 0 #/gal
VOC excluding water: 0 grams/liter and 0 #/gal
Volatile portion: 45-75 % wt
Specific Gravity: 1.0-1.3 @20°C
Solubility in water: Dilutable
Boiling Point: 100°C
pH: 7.5 - 9
Freezing Point: 0°C
Viscosity: 60-85 KU
Vapor Pressure: Negligible
Appearance and Odor: Thick White Liquid / mild odor
Conditions and materials to avoid: High temperatures, oxidizing conditions.
Hazardous decomposition products: Acrid smoke, fumes, carbon monoxide/dioxide may be released upon decomposition.

PART 4 - FIRE AND EXPLOSION

Flash Point: > 250°C (Method: ISO 3679)
Autoignition temperature: N/DA
Flammable limits (%volume in air) Lower: N/DA Upper: N/DA
Fire and explosion hazards: Not-flammable
Extinguishing media: Dry chemical, CO_2, Water spray, Foam, Water fog.
Special fire-fighting procedures: Do not enter fire area without special protection. Fight fire from safe distance or protected location. Heat or impurities may increase temperature, build pressure, rupture closed containers spreading fire and increase the risk of burns and injuries. Use water spray/fog for cooling. Notify authorities if liquid enters sewer or public waters.

PART 5 - EMERGENCY AND FIRST AID

Inhalation: If overcome by exposure, remove victim to fresh air immediately. Give oxygen or artificial respiration as needed. Obtain emergency medical attention, prompt action is essential.
Eye Contact: In case of eye contact, immediately flush eyes with clean water for 20 - 30 minutes. Retract eyelids often. Obtain emergency medical attention if pain, blinking, tears, or redness persist.
Skin Contact: Remove contaminated clothing as needed. Wash skin thoroughly with mild soap and water. Flush with lukewarm water for 15 minutes. If sticky, use waterless hand cleaner first.
Ingestion: If large quantity is swallowed, give lukewarm water (1 pint) if victim is completely conscious and alert. Do not induce vomiting, risk of damage to lungs exceeds poisoning risk. Obtain emergency medical attention.
Emergency Medical Treatment: Treat symptomatically.

PART 6 - EFFECTS OF EXPOSURE

Routes of exposure:
Inhalation: This material is not expected to present an inhalation hazard at standard conditions due to its low volatility. However, overexposure to mists/aerosols may cause respiratory tract irritation such as coughing, shortness of breath, and mucus production.
Eye Contact: Potential route. May cause eye irritation. Symptoms may include tearing, blinking, redness and swelling.
Skin absorption: Potential route. Although no data was found for this product, the potential for skin absorption does exist.
Skin Irritation: Potential route. May produce skin irritation. May cause an allergic skin reaction in some individuals after repeated skin contact.
Ingestion: This material may be a health hazard if ingested in large quantities.
Medical conditions aggravated by exposure: No additional medical information found.

PART 7 - PROTECTIVE EQUIPMENT AND CONTROL MEASURES

Respiratory Protection: If this material is handled under mist forming conditions, use NIOSH/MSHA approved respiratory protection equipment.
Eye Protection: Eye protection such as chemical splash goggles and/or face shield must be worn when possibility exists for eye contact due to splashing or spraying, liquid, airborne particles, or vapor. Contact lenses should not be worn.
Skin Protection: Depending on the conditions for use, protective gloves, apron, boots, head, and face protection should be worn. This equipment should be cleaned after each use.
Engineering Controls: If handling results in mist or aerosol or vapor generation, local exhaust ventilation is recommended.
Other Hygienic Practices: Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure.
Other Work Practices: Use good personal hygiene. Wash hands before eating, drinking, smoking, or using the toilet facilities. Promptly remove soiled clothing and wash thoroughly before reuse. Shower after work using plenty of soap and water.

PART 8 - REACTIVITY DATA

Stability: Stable
Incompatibility: Strong bases and acids.
Hazardous polymerization: Will not occur.
Hazardous decomposition: Will not occur.

PART 9 - SPILL OR LEAK PROCEDURES

Avoid all personal contact. Take up with absorbent material. Scoop and vacuum up, place in closed container for disposal. Avoid dusting. Flush contaminated area with water. Dispose in accordance with federal, state, and local regulations.

PART 10 - STORAGE AND SPECIAL PRECAUTIONS

SPECIAL PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE:
Practice caution and personal cleanliness to avoid skin and eye contact. Avoid breathing vapors of heated material.

PART 11 - REGULATORY INFORMATION

TRANSPORTATION
Not Regulated

PART 12 - LABEL INFORMATION

FOR INDUSTRIAL USE ONLY!! Skin contact hazard. Eye and skin irritant.
May cause allergic reaction. Avoid contact with eyes, skin, and clothing. Do not breath vapors or mist. Wash thoroughly after handling. Do not swallow. Prevent contact with food, chewing or smoking materials.

FIRST AID

EYES: Immediately flush with plenty of clean water
INHALATION: Remove to fresh air if effects occur. Consult a physician.
SKIN CONTACT: Wash thoroughly with mild soap and flowing water or shower.
INGESTION: Give fluids. Call a physician.
NOTE TO PHYSICIAN: No specific antidote. Supportive care. Treatment based on judgment of physician in response to reaction of the patient.

ADCO

Product Information Sheet

Product: Interior Wood Stain Cherry WST-5

Purpose: Highlighting the grain and adding to the beauty of uncoated wood surfaces. This waterbased wiping stain enriches the color and enhances the fade resistance of woods and provides a good base for almost any kind of clear topcoat. This is a Zero VOC product.

Weight per gallon : 8.57 pounds per gallon

Nonvolatile: 11.3% by weight

Dry Times: Dry times will vary upon atmospheric conditions and wood type. In most cases, it can be topcoated with 3 hours.

Surface Preparation: This product is intended for use on bare wood or wood with a conditioner used previously. If there is an existing coating, it must be sanded off. Sand wood surface with 120 grit or finer sandpaper (not steel wool) moving in the direction of the wood grain. Remove sanding dust.

Application: Stir stain thoroughly- do not shake. The stain may be applied with a nylon polyester brush, foam brush staining pad or clean lint-free rag. Allow stain to penetrate until color desired is achieved but do not let the stain dry out. Stain small areas and maintain a wet edge to unify appearance. While stain is still wet, remove the excess with a clean cloth. Wipe in the direction of the wood grain. A second application of the stain can be applied to intensify the color by letting the first coat dry for 1 hour then proceed as above.
Coverage- 400 square feet per gallon or 100 square feet per quart.
Thinning is not recommended but it may be diluted with water.

Let stain dry at least 3 hours before topcoating, overnight if using a solvent based topcoat
This is a stain and must be topcoated.

Cleanup with soap and water.

Do not allow product to freeze.

MATERIAL SAFETY DATA SHEET

PRODUCT: Adhesive Coatings Interior Wood Stain Cherry WST-5

PART 1 - GENERAL INFORMATION

Manufacturer:
Adhesive Coatings
2471 Peralta Street
Oakland, CA 94607
(510) 451-2470

NPCA HMIS Rating

Health:	1
Flammability:	0
Reactivity:	0
Personal Protection:	D

Emergency Numbers: 1-800-424-9300 (Chemtrec)

Chemical Family:	Latex Paint
Generic Name:	Water Based Paint
DOT Proper Shipping Name:	Water Based Paint, n.o.s.
DOT Hazard Class:	Not Regulated

Revision: 3 Date: 3/16/01

PART 2 - Ingredients

Ingredient Name	CAS #	%weight	OSHA(pel)	ACGIH(tlv)
Acrylic Co-polymer	25987-66-0	20-40	n/a	n/a

PART 3 - PHYSICAL AND CHEMICAL DATA

VOC of Material: 0 grams/liter and 0 #/gal
VOC excluding water: 0 grams/liter and 0 #/gal
Volatile portion: 65-90 % wt
Specific Gravity: 1.0-1.3 @20°C
Solubility in water: Dilutable
Appearance and Odor: Thick White Liquid / mild odor

Boiling Point: 100°C
pH: 7.5 - 9
Freezing Point: 0°C
Viscosity: 60-85 KU
Vapor Pressure: Negligible

Conditions and materials to avoid: High temperatures, oxidizing conditions.
Hazardous decomposition products: Acrid smoke, fumes, carbon monoxide/dioxide may be released upon decomposition.

PART 4 - FIRE AND EXPLOSION

Flash Point: > 250°C (Method: ISO 3679)
Autoignition temperature: N/DA
Flammable limits (%volume in air) Lower: N/DA Upper: N/DA
Fire and explosion hazards: Not-flammable
Extinguishing media: Dry chemical, CO_2, Water spray, Foam, Water fog.
Special fire-fighting procedures: Do not enter fire area without special protection. Fight fire from safe distance or protected location. Heat or impurities may increase temperature, build pressure, rupture closed containers spreading fire and increase the risk of burns and injuries. Use water spray/fog for cooling. Notify authorities if liquid enters sewer or public waters.

PART 5 - EMERGENCY AND FIRST AID

Inhalation: If overcome by exposure, remove victim to fresh air immediately. Give oxygen or artificial respiration as needed. Obtain emergency medical attention, prompt action is essential.
Eye Contact: In case of eye contact, immediately flush eyes with clean water for 20 - 30 minutes. Retract eyelids often. Obtain emergency medical attention if pain, blinking, tears, or redness persist.
Skin Contact: Remove contaminated clothing as needed. Wash skin thoroughly with mild soap and water. Flush with lukewarm water for 15 minutes. If sticky, use waterless hand cleaner first.
Ingestion: If large quantity is swallowed, give lukewarm water (1 pint) if victim is completely conscious and alert. Do not induce vomiting, risk of damage to lungs exceeds poisoning risk. Obtain emergency medical attention.
Emergency Medical Treatment: Treat symptomatically.

PART 6 - EFFECTS OF EXPOSURE

Routes of exposure:
Inhalation: This material is not expected to present an inhalation hazard at standard conditions due to its low volatility. However, overexposure to mists/aerosols may cause respiratory tract irritation such as coughing, shortness of breath, and mucus production.
Eye Contact: Potential route. May cause eye irritation. Symptoms may include tearing, blinking, redness and swelling.
Skin absorption: Potential route. Although no data was found for this product, the potential for skin absorption does exist.
Skin Irritation: Potential route. May produce skin irritation. May cause an allergic skin reaction in some individuals after repeated skin contact.
Ingestion: This material may be a health hazard if ingested in large quantities.
Medical conditions aggravated by exposure: No additional medical information found.

PART 7 - PROTECTIVE EQUIPMENT AND CONTROL MEASURES

Respiratory Protection: If this material is handled under mist forming conditions, use NIOSH/MSHA approved respiratory protection equipment.
Eye Protection: Eye protection such as chemical splash goggles and/or face shield must be worn when possibility exists for eye contact due to splashing or spraying, liquid, airborne particles, or vapor. Contact lenses should not be worn.
Skin Protection: Depending on the conditions for use, protective gloves, apron, boots, head, and face protection should be worn. This equipment should be cleaned after each use.
Engineering Controls: If handling results in mist or aerosol or vapor generation, local exhaust ventilation is recommended.
Other Hygienic Practices: Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure.
Other Work Practices: Use good personal hygiene. Wash hands before eating, drinking, smoking, or using the toilet facilities. Promptly remove soiled clothing and wash thoroughly before reuse. Shower after work using plenty of soap and water.

PART 8 - REACTIVITY DATA

Stability: Stable
Incompatibility: Strong bases and acids.
Hazardous polymerization: Will not occur.
Hazardous decomposition: Will not occur.

PART 9 - SPILL OR LEAK PROCEDURES

Avoid all personal contact. Take up with absorbent material. Scoop and vacuum up, place in closed container for disposal. Avoid dusting. Flush contaminated area with water. Dispose in accordance with federal, state, and local regulations.

PART 10 - STORAGE AND SPECIAL PRECAUTIONS

SPECIAL PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE:
Practice caution and personal cleanliness to avoid skin and eye contact. Avoid breathing vapors of heated material.

PART 11 - REGULATORY INFORMATION

TRANSPORTATION
Not Regulated

PART 12 - LABEL INFORMATION

FOR INDUSTRIAL USE ONLY!! Skin contact hazard. Eye and skin irritant.
May cause allergic reaction. Avoid contact with eyes, skin, and clothing. Do not breath vapors or mist. Wash thoroughly after handling. Do not swallow. Prevent contact with food, chewing or smoking materials.

FIRST AID

EYES: Immediately flush with plenty of clean water
INHALATION: Remove to fresh air if effects occur. Consult a physician.
SKIN CONTACT: Wash thoroughly with mild soap and flowing water or shower.
INGESTION: Give fluids. Call a physician.
NOTE TO PHYSICIAN: No specific antidote. Supportive care. Treatment based on judgment of physician in response to reaction of the patient.

ADCO

Product Information Sheet

Product: Sanding Sealer WSS-9D

Purpose: To seal the grain of uncoated wood or stains and allow sanding to smooth the surface before topcoats are applied . This is a fast drying waterbased clear sealer with Zero VOCs that can be applied by brush or spray. It provides a high clarity sealer that is stearate free for maximum topcoat adhesion. This sealer is compatible with most topcoats except solventborne nitrocellulose types. Check compatibilty first.

Weight per gallon: 8.63
Nonvolatile: 26-27 %
Flashpoint: > 200° F

Dry Times: 1 hour to recoat with most waterbased finishes, dependent film thickness and on atmospheric conditions. Solventborne topcoats may take longer. Dry to sand in 1- 3 hours dependent upon film thickness and on atmospheric conditions.

Surface preparation: The wood should be clean and dry. If being used on new wood, sand the wood in the direction of the grain lightly with 120 grit sandpaper (not steel wool). Remove dust. Over stained wood, the stain must be fully cured, see stain manufacturer's recommendations.

Application: Stir before application- do not shake. The sealer may be sprayed with a conventional airgun, HPLV gun, airless (.017 tip) or brushed. Rolling is not recommended. A full wet brush coat or 3-4 mils wet spray coat is recommended. The sealer will be ready for sanding in 3-4 hours depending on weather conditions. Grain raise will occur to differing degrees depending on the wood and whether or not it was stained. Often soft woods such as pine will have more grain raise and hardwoods such as cherry will have less. Oak will have more grain raise than maple. The sealer should be sanded with 220 or finer before the topcoat is applied.

Coverage: 350-400 sq.ft/gal

Thinning is not recommended

Clean up with soap and water

Protect from freezing

MATERIAL SAFETY DATA SHEET

PRODUCT: Adhesive Coatings Sanding Sealer WSS-9D

PART 1 - GENERAL INFORMATION

Manufacturer:
Adhesive Coatings
2471 Peralta Street
Oakland, CA 94607
(510) 451-2470

NPCA HMIS Rating

Health:	1
Flammability:	0
Reactivity:	0
Personal Protection:	D

Emergency Numbers: 1-800-424-9300 (Chemtrec)

Chemical Family:	Latex Paint
Generic Name:	Water Based Paint
DOT Proper Shipping Name:	Water Based Paint, n.o.s.
DOT Hazard Class:	Not Regulated

Revision: 3 Date: 3/16/01

PART 2 - Ingredients

Ingredient Name	CAS #	%weight	OSHA(pel)	ACGIH(tlv)
Acrylic Co-polymer	25987-66-0	20-40	n/a	n/a

PART 3 - PHYSICAL AND CHEMICAL DATA

VOC of Material: 0 grams/liter and 0 #/gal
VOC excluding water: 0 grams/liter and 0 #/gal
Volatile portion: 45-75 % wt
Specific Gravity: 1.0-1.3 @20°C
Solubility in water: Dilutable
Boiling Point: 100°C
pH: 7.5 - 9
Freezing Point: 0°C
Viscosity: 50-75 KU
Vapor Pressure: Negligible
Appearance and Odor: Thick White Liquid / mild odor
Conditions and materials to avoid: High temperatures, oxidizing conditions.
Hazardous decomposition products: Acrid smoke, fumes, carbon monoxide/dioxide may be released upon decomposition.

PART 4 - FIRE AND EXPLOSION

Flash Point: > 250°C (Method: ISO 3679)
Autoignition temperature: N/DA
Flammable limits (%volume in air) Lower: N/DA Upper: N/DA
Fire and explosion hazards: Not-flammable
Extinguishing media: Dry chemical, CO_2, Water spray, Foam, Water fog.
Special fire-fighting procedures: Do not enter fire area without special protection. Fight fire from safe distance or protected location. Heat or impurities may increase temperature, build pressure, rupture closed containers spreading fire and increase the risk of burns and injuries. Use water spray/fog for cooling. Notify authorities if liquid enters sewer or public waters.

PART 5 - EMERGENCY AND FIRST AID

Inhalation: If overcome by exposure, remove victim to fresh air immediately. Give oxygen or artificial respiration as needed. Obtain emergency medical attention, prompt action is essential.
Eye Contact: In case of eye contact, immediately flush eyes with clean water for 20 - 30 minutes. Retract eyelids often. Obtain emergency medical attention if pain, blinking, tears, or redness persist.
Skin Contact: Remove contaminated clothing as needed. Wash skin thoroughly with mild soap and water. Flush with lukewarm water for 15 minutes. If sticky, use waterless hand cleaner first.
Ingestion: If large quantity is swallowed, give lukewarm water (1 pint) if victim is completely conscious and alert. Do not induce vomiting, risk of damage to lungs exceeds poisoning risk. Obtain emergency medical attention.
Emergency Medical Treatment: Treat symptomatically.

PART 6 - EFFECTS OF EXPOSURE

Routes of exposure:
Inhalation: This material is not expected to present an inhalation hazard at standard conditions due to its low volatility. However, overexposure to mists/aerosols may cause respiratory tract irritation such as coughing, shortness of breath, and mucus production.
Eye Contact: Potential route. May cause eye irritation. Symptoms may include tearing, blinking, redness and swelling.
Skin absorption: Potential route. Although no data was found for this product, the potential for skin absorption does exist.
Skin Irritation: Potential route. May produce skin irritation. May cause an allergic skin reaction in some individuals after repeated skin contact.
Ingestion: This material may be a health hazard if ingested in large quantities.
Medical conditions aggravated by exposure: No additional medical information found.

PART 7 - PROTECTIVE EQUIPMENT AND CONTROL MEASURES

Respiratory Protection: If this material is handled under mist forming conditions, use NIOSH/MSHA approved respiratory protection equipment.
Eye Protection: Eye protection such as chemical splash goggles and/or face shield must be worn when possibility exists for eye contact due to splashing or spraying, liquid, airborne particles, or vapor. Contact lenses should not be worn.
Skin Protection: Depending on the conditions for use, protective gloves, apron, boots, head, and face protection should be worn. This equipment should be cleaned after each use.
Engineering Controls: If handling results in mist or aerosol or vapor generation, local exhaust ventilation is recommended.
Other Hygienic Practices: Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure.
Other Work Practices: Use good personal hygiene. Wash hands before eating, drinking, smoking, or using the toilet facilities. Promptly remove soiled clothing and wash thoroughly before reuse. Shower after work using plenty of soap and water.

PART 8 - REACTIVITY DATA

Stability: Stable
Incompatibility: Strong bases and acids.
Hazardous polymerization: Will not occur.
Hazardous decomposition: Will not occur.

PART 9 - SPILL OR LEAK PROCEDURES

Avoid all personal contact. Take up with absorbent material. Scoop and vacuum up, place in closed container for disposal. Avoid dusting. Flush contaminated area with water. Dispose in accordance with federal, state, and local regulations.

PART 10 - STORAGE AND SPECIAL PRECAUTIONS

SPECIAL PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE:
Practice caution and personal cleanliness to avoid skin and eye contact. Avoid breathing vapors of heated material.

PART 11 - REGULATORY INFORMATION

TRANSPORTATION
Not Regulated

PART 12 - LABEL INFORMATION

FOR INDUSTRIAL USE ONLY!! Skin contact hazard. Eye and skin irritant.
May cause allergic reaction. Avoid contact with eyes, skin, and clothing. Do not breath vapors or mist. Wash thoroughly after handling. Do not swallow. Prevent contact with food, chewing or smoking materials.

FIRST AID

EYES: Immediately flush with plenty of clean water
INHALATION: Remove to fresh air if effects occur. Consult a physician.
SKIN CONTACT: Wash thoroughly with mild soap and flowing water or shower.
INGESTION: Give fluids. Call a physician.
NOTE TO PHYSICIAN: No specific antidote. Supportive care. Treatment based on judgment of physician in response to reaction of the patient.

ADCO

Product Information Sheet

Product: Waterproofing Sealer WPS-2

Purpose: A film forming clear sealer for masonry or wood to protect from water. This product is Zero VOC and has very low flammability.

Weight per gallon : 8.38

Nonvolatile : 21.5-22.5%

Surface Preparation: The surface should be free of mildew, dust, oil, soot, and grease. It should be clean and dry.

Application: Stir thoroughly. Do not shake . The sealer maybe applied by brush, roll or low pressure sprayer such as a garden sprayer. The product should be applied until a puddle of sealer remains on the surface for 2 minutes and then redistributed or taken up.

Coverage: This will depend on the porosity of the surface that you are coating.

poured concrete	175- 200 sq.ft /gal
rough sawn wood	100 sq.ft/gal
smooth wood	200-250 sq.ft/gal
porous clay tile	175- 200 sq.ft/gal.
plywood	175-200 sq.ft/gal.

Thinning is not recommended

Clean up with soap and water

Protect from Freezing

MATERIAL SAFETY DATA SHEET

PRODUCT: Adhesive Coatings Waterproofing Sealer WPS-2

PART 1 - GENERAL INFORMATION

Manufacturer:
Adhesive Coatings
2471 Peralta Street
Oakland, CA 94607
(510) 451-2470

NPCA HMIS Rating

Health:	1
Flammability:	0
Reactivity:	0
Personal Protection:	D

Emergency Numbers: 1-800-424-9300 (Chemtrec)

Chemical Family:	Latex Paint
Generic Name:	Water Based Paint
DOT Proper Shipping Name:	Water Based Paint, n.o.s.
DOT Hazard Class:	Not Regulated

Revision: 3 Date: 3/16/01

PART 2 - Ingredients

Ingredient Name	CAS #	%weight	OSHA(pel)	ACGIH(tlv)
Acrylic Co-polymer	25987-66-0	10-50	n/a	n/a

PART 3 - PHYSICAL AND CHEMICAL DATA

VOC of Material: 0 grams/liter and 0 #/gal
VOC excluding water: 0 grams/liter and 0 #/gal
Volatile portion: 55-85 % wt
Specific Gravity: 1.0-1.3 @20°C
Solubility in water: Dilutable
Boiling Point: 100°C
pH: 7.5 - 9
Freezing Point: 0°C
Viscosity: 50-75 KU
Vapor Pressure: Negligible
Appearance and Odor: Thick White Liquid / mild odor
Conditions and materials to avoid: High temperatures, oxidizing conditions.
Hazardous decomposition products: Acrid smoke, fumes, carbon monoxide/dioxide may be released upon decomposition.

PART 4 - FIRE AND EXPLOSION

Flash Point: > 250°C (Method: ISO 3679)
Autoignition temperature: N/DA
Flammable limits (%volume in air) Lower: N/DA Upper: N/DA
Fire and explosion hazards: Not-flammable
Extinguishing media: Dry chemical, CO_2, Water spray, Foam, Water fog.
Special fire-fighting procedures: Do not enter fire area without special protection. Fight fire from safe distance or protected location. Heat or impurities may increase temperature, build pressure, rupture closed containers spreading fire and increase the risk of burns and injuries. Use water spray/fog for cooling. Notify authorities if liquid enters sewer or public waters.

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Skin Contact: Remove contaminated clothing as needed. Wash skin thoroughly with mild soap and water. Flush with lukewarm water for 15 minutes. If sticky, use waterless hand cleaner first.
Ingestion: If large quantity is swallowed, give lukewarm water (1 pint) if victim is completely conscious and alert. Do not induce vomiting, risk of damage to lungs exceeds poisoning risk. Obtain emergency medical attention.
Emergency Medical Treatment: Treat symptomatically.

PART 6 - EFFECTS OF EXPOSURE

Routes of exposure:
Inhalation: This material is not expected to present an inhalation hazard at standard conditions due to its low volatility. However, overexposure to mists/aerosols may cause respiratory tract irritation such as coughing, shortness of breath, and mucus production.
Eye Contact: Potential route. May cause eye irritation. Symptoms may include tearing, blinking, redness and swelling.
Skin absorption: Potential route. Although no data was found for this product, the potential for skin absorption does exist.
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Ingestion: This material may be a health hazard if ingested in large quantities.
Medical conditions aggravated by exposure: No additional medical information found.

PART 7 - PROTECTIVE EQUIPMENT AND CONTROL MEASURES

Respiratory Protection: If this material is handled under mist forming conditions, use NIOSH/MSHA approved respiratory protection equipment.
Eye Protection: Eye protection such as chemical splash goggles and/or face shield must be worn when possibility exists for eye contact due to splashing or spraying, liquid, airborne particles, or vapor. Contact lenses should not be worn.
Skin Protection: Depending on the conditions for use, protective gloves, apron, boots, head, and face protection should be worn. This equipment should be cleaned after each use.
Engineering Controls: If handling results in mist or aerosol or vapor generation, local exhaust ventilation is recommended.
Other Hygienic Practices: Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure.
Other Work Practices: Use good personal hygiene. Wash hands before eating, drinking, smoking, or using the toilet facilities. Promptly remove soiled clothing and wash thoroughly before reuse. Shower after work using plenty of soap and water.

PART 8 - REACTIVITY DATA

Stability: Stable
Incompatibility: Strong bases and acids.
Hazardous polymerization: Will not occur.
Hazardous decomposition: Will not occur.

PART 9 - SPILL OR LEAK PROCEDURES

Avoid all personal contact. Take up with absorbent material. Scoop and vacuum up, place in closed container for disposal. Avoid dusting. Flush contaminated area with water. Dispose in accordance with federal, state, and local regulations.

PART 10 - STORAGE AND SPECIAL PRECAUTIONS

SPECIAL PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE:
Practice caution and personal cleanliness to avoid skin and eye contact. Avoid breathing vapors of heated material.

PART 11 - REGULATORY INFORMATION

TRANSPORTATION
Not Regulated

PART 12 - LABEL INFORMATION

FOR INDUSTRIAL USE ONLY!! Skin contact hazard. Eye and skin irritant.
May cause allergic reaction. Avoid contact with eyes, skin, and clothing. Do not breath vapors or mist. Wash thoroughly after handling. Do not swallow. Prevent contact with food, chewing or smoking materials.

FIRST AID

EYES: Immediately flush with plenty of clean water
INHALATION: Remove to fresh air if effects occur. Consult a physician.
SKIN CONTACT: Wash thoroughly with mild soap and flowing water or shower.
INGESTION: Give fluids. Call a physician.
NOTE TO PHYSICIAN: No specific antidote. Supportive care. Treatment based on judgment of physician in response to reaction of the patient.

Appendix F

VOC Emissions Reduction Calculation

With Future VOC Limit	With New Coating VOC	VOC Emission Decrease With Future	VOC Emission Decrease With New Coating
332,633	327,287		
275	50		
0.599	0.703		
0.125	0.017		
0.276	0.280		
152.80	20.25	406.55	539.10
0.42	0.06	1.11	1.48

With Future VOC Limit	With New Coating VOC	VOC Emission Decrease With Future	VOC Emission Decrease With New Coating
855,582	1,967,838		
250	50		
0.679	0.894		
0.091	0.006		
0.230	0.100		
286.45	43.49	139.35	382.31
0.78	0.12	0.38	1.05

With Future VOC Limit	With New Coating VOC	VOC Emission Decrease With Future	VOC Emission Decrease With New Coating
	463,997		
	50		
	0.682		
	0.018		
	0.300		
	30.76		374.61
	0.08		1.03

With Future VOC Limit	With New Coating VOC	VOC Emission Decrease With Future	VOC Emission Decrease With New Coating
161,217	272,529		
250	50		
0.481	0.767		
0.148	0.013		
0.372	0.220		
87.28	13.25	190.87	264.90
0.24	0.04	0.52	0.73

With Future VOC Limit	With New Coating VOC	VOC Emission Decrease With Future	VOC Emission Decrease With New Coating
	56,343		
	50		
	0.735		
	0.015		
	0.250		
	3.11		73.00
	0.01		0.20

With Future VOC Limit	With New Coating VOC	VOC Emission Decrease With Future	VOC Emission Decrease With New Coating
67,725	127,662		
250	50		
0.421	0.767		
0.165	0.013		
0.415	0.220		
40.88	6.21	42.74	77.42
0.11	0.02	0.12	0.21

CATEGORY	VOC EMISSSIONS (tpd) Current Limit	EMIS REDUC (tpd) Future Limit	EMIS REDUC (tpd) No-VOC Coatings
Clear Wood Finishes-Lacquers	1.53	1.11	0.37
Semitransparent Stains	1.17	0.38	0.67
Clear Wood Finishes-Varnishes	1.11		1.03
Waterproofing Sealer	0.76	0.52	0.21
Sanding Sealers	0.21	0.01	0.19
Opaque Stains	0.23	0.12	0.09
TOTAL	**5.01**	**2.14**	**2.56**

Assumptions:

All no-VOC coatings assumed at 50 g/l VOC

Appendix G

CALCOAST Laboratory Brochure

Calcoast Labs and DL Labs are independent full service materials testing laboratories specializing in the analysis of commercial products such as paints, coatings, sealants and building materials. DL Labs is accredited by the NIST (NVLAP) and the Canadian General Standards Board (CGSB) and is also 1SO.9002 / IEC25 approved. Calcoast is certified by the Los Angeles Department of Building and Safety for materials testing, the Federal Drug Enforcement Agency (DEA) for drug analysis, and the California Department of Health Services for hazardous waste analysis.

Laboratory Services

- Failure Analysis
- Conformance testing
- Specification writing
- Building & site sampling
- Coatings formulation
- Microbiological testing
- Quantitative analysis
- Forensic analysis
- Hazardous waste analysis
- Personnel Training
- Industry Surveys
- Market Development
- Testing & Evaluation
- Instrument Calibration
- Certification Testing
- Drug analysis
- Litigation support
- Expert Testimony

Instrumentation and Analytical Techniques

- X-Ray Fluorescence Spectrophotometry
- Atomic Absorption Spectrophotometry
- Gas Chromatography and GC / Mass Spectrometry
- Fourier Transform Infra-red Spectroscopy
- UV-VIS Spectrometry
- High Pressure Liquid Chromatography & Thin Layer Chromatography
- Scanning Electron Microscopy / EDX
- Borescopic & Light Microscopy
- Differential Scanning Calorimetry
- Melt flow index
- Instron Mechanical Testing

Calcoast Labs
4072 Watts Street
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Fax: 212-505-8419
www.dllabs.com

CALCOAST LABS

California

Robert A. Haffner
Technical Director-Vice President

Antoine Y. Chamsi, Ph. D.
Vice President-Materials Chemistry

Thomas J. Sliva
Technical Director-Vice President

DL LABS

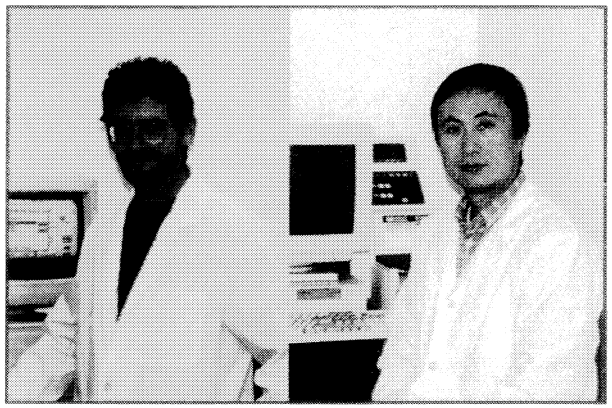
New York

Hazardous Waste Materials

We are licensed by the State of California Department of Health Services (ELAP) for hazardous waste analysis. Services include: field sampling, analysis of toxic metals and trace organic contaminants and waste stream effluent monitoring.

Formulation & Product Development

Competitor product analytical matching and deformulation as well as product development in coatings, wood, wood composite and related products.



Thomas R. Fairley
Coatings Specialist

Kevin S. Yan, Ph.D.
Research Scientist

Mechanical and Forensic Analysis

We are experienced in hit-and-run accident evaluation using paint transfer analysis techniques for land and sea vessels.

Arson analysis is performed utilizing Direct Injection, Headspace GC and Mass Spectrometry / Gas Chromatography (MS/GC).

Microbiological Testing

Microbiological testing to Federal, Military and ASTM test procedures for coatings, adhesives, rubbers and other organic polymers, including air sampling for air-borne microbiological pollutants.

Specification Testing

We have extensive background and experience testing coatings and related materials to the requirements of Military, Federal, Boeing, Canadian and other specifications. We do QPL testing for Naval Air and NAVSEA. We are also experienced with the testing of traffic paints and elastomeric roofing materials for conformance to their respective specifications as well as the testing of products used to encapsulate lead-based paint products.

Quantitative Analysis

Identification of organic polymers by Fourier Transform Infra-red Spectroscopy (FTIR) using transmittance and surface (ATR) analysis techniques.

Complete analysis of inorganic components by X-ray Fluorescence and Atomic Absorption Spectroscopy. Solvent and Volatile Organic Content (VOC) analysis using Gas and Liquid Chromatography with EC, TC, FID and NPS detectors by direct injection or headspace analysis. Drug analysis using HPLC and Thin Layer Chromatography.

DL Laboratory Staff

Saul Spindel

Sealant Testing

The laboratories have a broad background in the testing of building seal and sealant materials for conformance to ASTM, ISO and Federal specification. Lab personnel have been in the forefront of developing test methodology as a result of our activity in ASTM C-24, the premier committee for the development of sealant standards.

Failure Analysis

Our personnel are skilled in analytical and microscopic evaluation of field failures of coatings on all substrates and building materials such as sealants, industrial flooring and plastic pipes.

Expert Witness & Litigation Technical Services

Our personnel participate in technical support and expert witness testimony in the fields of coating and materials failures and disputes, slip and fall personal injuries and hazardous materials.

Drug Analysis

We are licensed by the Federal Drug Enforcement Agency (DEA). Both private and forensic drug analyses are performed.